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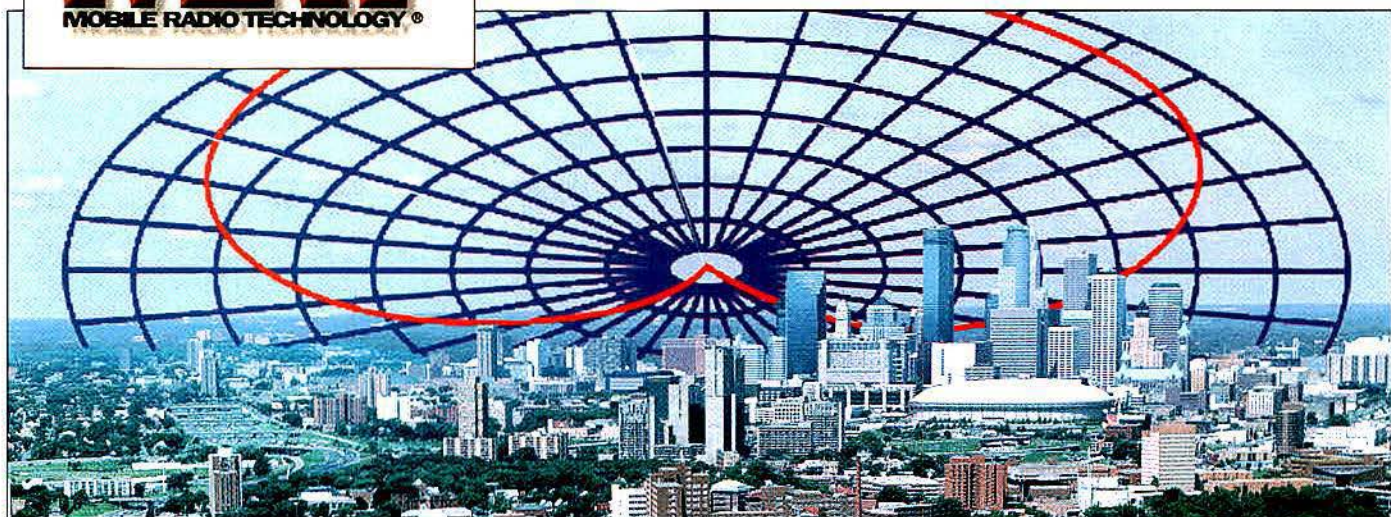
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On the cover: As site buildouts continue, CDMA-based service providers seek ways to optimize system performance. Graphic courtesy of Celwave; cover design by Scott Dolash, associate art director. See story on page 18.

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Making a difference



FCC Commissioner Gloria Tristani addressed the annual conference for the Associated Public-Safety Communications Officials on Aug. 10 in Albuquerque, NM. FCC commissioners, you see, traditionally take an area of focus within telecommunications, and Tristani has expressed an interest in public safety communications. Commissioner Michael Powell, for example, is known as the defense commissioner. None of the four new commissioners nor the veteran, Susan Ness, has (as far as we know) expressed a particular interest in private land mobile radio, or private wireless, as some have begun to call it.

"I know that the public safety community has identified three critical issues in the area of spectrum: insufficient frequencies overall; the need for interoperability among diverse agencies and jurisdictions; and the need for future flexibility to avail yourselves of new developments in technology," Tristani said.

Referring to the commission's Aug. 6 release of service rules for 24MHz of spectrum in the 700MHz band for public safety communications, Tristani said: "Our service and licensing rules for this new 24MHz will give you tools to meet these needs.

Let's stop for a moment and consider. The public safety lobby has stated a need for about 100MHz of spectrum to meet its needs. Portions of the 24MHz may soon be made available, but long delays may be experienced by would-be licensees in large

cities where the spectrum is tied up by TV stations.

The matter of *interoperability* can be a point of disagreement. For some, interoperability means second-sourcing; that is, various manufacturers' equipment will work on a given public safety radio network. That kind of interoperability allows competition to drive prices closer to cost, reducing expenses for public safety agencies.

For others—some manufacturers, in this case—interoperability means: "If you buy my radio system for countywide [or whatever jurisdiction] communications, then all of the city and county agencies can communicate with one another using our brand of radios."

From the federal government's perspective, interoperability seems to mean the ability of federal, state and local agencies to communicate with one another when their employees are responding to the same incident or who could benefit from the same information.

"We all know the stories," Tristani said. "Like the officers who stopped a man who kidnapped, and later murdered, a little girl—who stopped him from trespassing, and who thought his behavior odd. But, who had no cause to hold him because they had no immediate access to his criminal record, and they could not hear the announcement of the kidnapping, broadcast by another department on a different channel.

"Or, like the local rescue workers who recently responded to a terrible car crash near a military base. One of the vehicles was badly crushed and the 'jaws of life' were called in to cut the frame of the car and release the driver. When the 'jaws of life' blew a hydraulic hose, a desperate call went out for a replacement. One was found 30 minutes away, but by the time it arrived, the driver had died. *Only then* did rescue personnel discover a spare hose, sitting the whole time in a military truck, not 100 yards away, but unused because the military units were on a different radio system and they couldn't hear the distress call."

Whether the new 24MHz of spectrum will help to reconcile these viewpoints of interoperability remains to be seen, but at least it will provide an opportunity for new system configurations that can allow various government authorities to consider the alternatives.

* * *

U.S. Sen. John McCain (R-AZ) and FCC Chairman William E. Kennard have exchanged letters in the latest round of congressional efforts to oversee and direct the commission's work. McCain is chairman of the Committee on Commerce, Science and Transportation, which has responsibility for overseeing the commission's work and for developing telecommunications legislation.

On June 24, McCain wrote to Kennard to express dissatisfaction with the commission's lack of action for several years in resolving a matter connected with license application mills that has tied up 220MHz licenses. Had the matter been resolved quickly, those frequencies might have been released to private users. Now, however the matter is resolved the frequencies are set to be auctioned.

Sometimes the FCC votes in an open meeting; sometimes a matter is "circulated" from one commissioner's office to another for a voting process that extends over days or weeks. Chairman Kennard responded on July 9 to say that an order to resolve the matter began circulating on June 26; that he voted on it on June 29; and that the rest of the commissioners were expected to vote by July 16.

On July 31, the FCC released its order, which was adopted on July 16 as scheduled. It reinstates some licenses that were canceled, upholds the cancellation of others, and schedules a time for publishing the order in the *Federal Register* to make it effective.

None of this probably will make any difference to the license-holders, who are unlikely to recover much, if anything, of their investment. None of this probably will make any difference to private wireless operators, who are likely to be closed out of a process to reassign the licenses. And, oddly enough, none of this probably came about because of McCain's letter. The FCC probably was motivated to "clear the title" to the frequencies so they could be auctioned. Were it not for the pending auction, the matter may have continued unresolved indefinitely. Not that it would have made any difference.

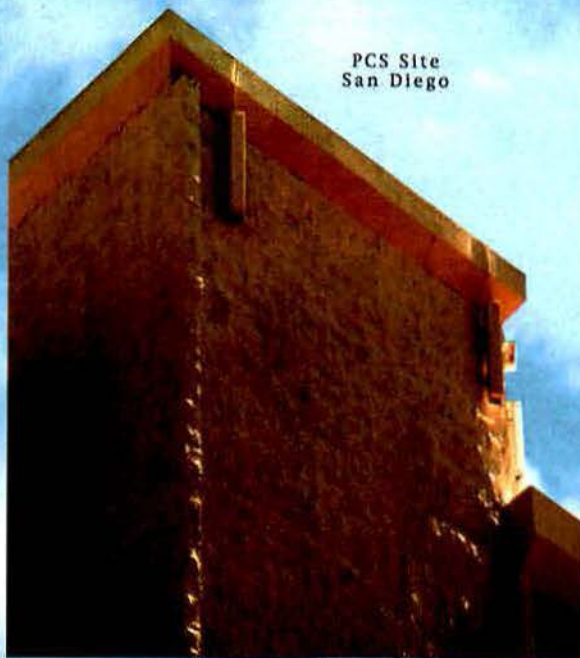
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Vehicular repeater technology for 800MHz
Path Profiles for PCS
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calendar

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23-25—Personal Communications Showcase, sponsored by Personal Communications Industry Association, Orange County Convention Center, Orlando, FL. Contact: 703-739-0300.

23-25—PCS Latin America, sponsored by the Personal Communications Industry Association, Orlando, FL. Contact: Cathy Graham, 703-739-0300, ext. 3706.

October

12-14—Wireless I.T. '98, sponsored by the Cellular Telecommunications Industry Association, Bally's Las Vegas, Las Vegas. Contact: 202-785-2842.

14-16—TelecomLatina, co-sponsored by *Mobile Radio Technology*, Miami Beach Convention Center, Miami. Contact: 800-288-8606.

19-21—RF Design Conference & Expo, sponsored by *RF Design* magazine, San Jose Convention Center, San Jose, CA. Contact: 800-288-8606.

20-21—Wireless Interconnection, sponsored by Belcore, Mesa Pavilion Hilton, Phoenix, AZ. Contact: 800-521-2673.

28-31—Industrial Telecommunications and USMSS joint annual conference, Grand Hyatt Hotel, Washington, DC. Contact: 703-528-5115.

November

4-5—ENTELEC and UTC Joint Seminar on Emerging Wireless Communications, Adams Mark Hotel, Houston. Contact: 202-872-0030; www.utc.org

11-15—Communications Marketing Conference, sponsored by the Communications Marketing Association, San Diego Princess Resort, San Diego. Contact: Bernie Brownson, 303-371-8182.

12-13—AMTEX, sponsored by the American Mobile Telecommunications Association, Fontainebleau Hilton, Miami. Contact: 202-331-7773.

12-13—Third International Congress on Commercial Trunked Radio, sponsored by the International Mobile Telecommunications Association, Fontainebleau Hilton, Miami. Contact: 202-331-7773.

20—Radio Club of America Communications Symposium, 89th Anniversary Dinner and Awards Presentation, New York Athletic Club, New York. Contact: Gerri Hopkins, 908-842-5070.

1999

February

8-10—Wireless, sponsored by the Cellular Telecommunications Industry Association, Ernest Morial Convention Center, New Orleans. Contact: 847-940-2155.

March

8-9—Specialized Wireless Communications Management Conference, sponsored by AMTA, San Diego Hilton Beach and Tennis Resort, San Diego. Contact: 202-331-7773.

28-31—ENTELEC, sponsored by the Energy Telecommunications and Electrical Association, George R. Brown Convention Center, Houston. Contact: 281-357-8700.

April

28-30—International Wireless Communications Expo, co-sponsored by *Mobile Radio Technology*, Las Vegas Convention Center, Las Vegas. Contact: 800-288-8606.

June

1-3—Canadian Wireless, sponsored by the Canadian Wireless Telecommunications Association, Vancouver, Canada. Contact: 613-233-4888, ext. 102.

27-July 1—UTC Telecom '99, sponsored by UTC, Nashville, TN. Contact: 202-857-1881.

28-29—Leadership Conference & Annual Meeting, sponsored by AMTA, ANA Hotel, Washington, DC. Contact: 202-337-7773.

July

14-16—Communications Expo/Show of the Americas, Miami Beach Convention Center, Miami. Contact: Jackie Gonzales, 305-412-9000.

August

8-12—International Association of Public-Safety Communications Officials (APCO) National Conference, Minneapolis, MN. Contact: 904-322-2500.

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A failure to communicate



During the last two years, Kansas City, MO, firefighters have been caught in burning buildings with radios that do not work. A police officer, shot in the leg by a suspect, tried to radio for help—but got only static.

Many communications problems such as these started happening years after Kansas City awarded an \$18.5 million contract to Lynchburg, VA-based Ericsson to build a 800MHz digital trunked radio system. In 1997, before the city would accept the system and make a final payment, it went to bat against Ericsson because officers couldn't communicate in certain parts of the city. Come to find out, the signal strength was the main problem.

The city pointed fingers for two years, but the source was to blame all along. KC said it would sue Ericsson. When Ericsson

maintained that it merely built the system to the city's specifications, the city then said it would sue the original consulting firm, Sachs/Freeman Associates. The catch is that Kansas City officials wrote faulty specifications because they were unhappy with the consultant's advice. Building the system for the signal level recommended by the consultant would have cost about \$26 million.

The mayor of Kansas City finally stood up and took the blame (or acknowledged that the blame should not leave city hall) in May 1998. What is worse, Motorola, Sachs/Freeman and Ericsson warned the city that the proposed signal strength was too weak to meet the city's expectations.

The original specifications called for a 33dB signal loss to account for KC's trees, tall buildings and hills. That signal level would have provided coverage in 95% of the city 95% of the time.

The city went with a 21.5dB loss factor.

So the fingers point back to the city. A *Kansas City Star* editorial fumed, "A com-

mittee of midlevel bureaucrats, faced with a shortage of money, decided to build an insufficient system with insufficient funds, and didn't tell anyone about it."

What did these officials have in mind when they did this? Didn't they realize that building a public safety radio communications system without enough signal strength is like buying a computer without the printer? How did they expect police officers and firefighters to protect the public if they couldn't protect themselves?

When the city specified this system, it reduced the expense by \$8 million, but put 750,000 lives in jeopardy. Kansas City now needs to spend additional millions (the cost changes from day to day) to retroactively fix the system. The final cost may exceed the original \$26 million estimate.

Radio communication is essential to public safety. When it comes to installing a system, governments cannot take shortcuts. Stunts such as this threaten the safety of civilians and of the officers who protect them.

—Nikki Chandler, Associate Editor

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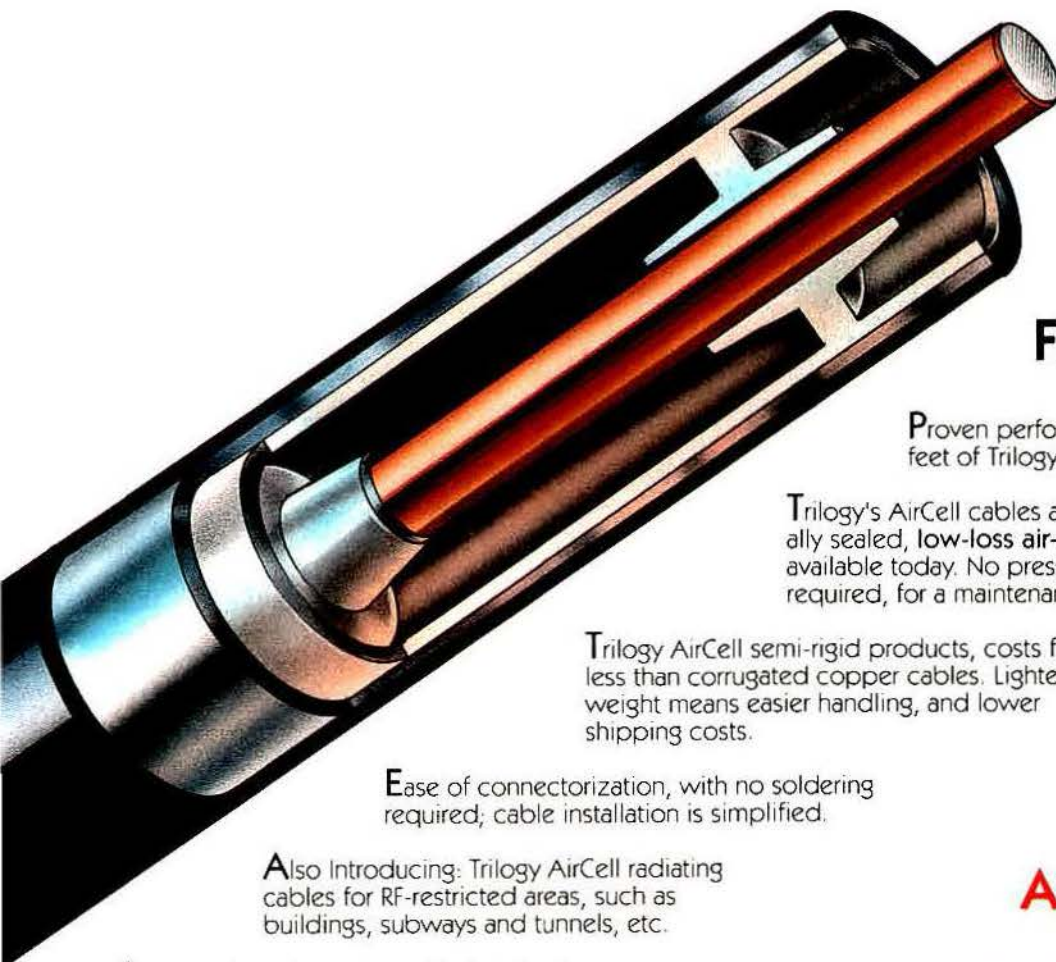
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letters

Is the technician glass half-full, or half-empty?

Thought I would respond to your question ("Editorial," July 1998) on whether your salary surveys would help to hire or retain technicians. Yes, depending on which side of the coin you are on.

When "the other guys" are trying to acquire talent (without paying their dues), they could look at the salary survey and know how much to pay if they were planning to be the high

bidder. This falls into a part of your "Viewpoint One—There is no shortage."

When the little guys (yes, I consider our organization one of the little guys) wanted to know if they were staying up with the Joneses, then your survey provided a measuring stick.

In our industry, there are still lots of old systems and equipment in service while new technologies are simultaneously put into place.

This makes it very hard from a training perspective. You need prior experience to handle

the legacy stuff, since there is no longer any active training available. The systems are old, and you have to be crazy to invest in learning them since they are slowly disappearing anyway. You also have to be trained on the latest technologies, or you will be left behind in the dust in our business.

Mix this up with all the different frequency bands, manufacturers and communications protocols and products in the land mobile communications world, and it makes for a really good training challenge.

At RCI we still do it the old-fashioned way, by providing fertile soil and the opportunity to grow. This method requires time and patience. With a whole lot of nurturing and occasional weeding, we experience a modicum of success. This is one of those easy to say, but hard to do, solutions to a problem. The success of the individual is frequently based upon the combination of their own personal efforts and the support efforts of their fellow technicians. Teamwork at its best.

Yes, there is a shortage. No, there is not a shortage. Is the technician glass half-full or half-empty? It's a matter of perspective.

—Tony Sabino

President, Regional Communications
Paramus, NJ

Quality technicians are becoming rare

I'd like to respond to your article ("Editorial," July 1998), which I find most interesting.

In "Viewpoint One—There is no shortage," it is true that those who pay well and nurture with training, equipment, reward and recognition will retain and probably not have a shortage of "good" technicians. But if not, good people are always looking for betterment somewhere else. In today's world, there is very little employee loyalty due to our (management's) loss of common sense.

In "Viewpoint Two—You better believe there is a shortage," good technicians are hard to find on the street because there are few fully trained in the way that was once the cornerstone of many large (communications) companies and even the armed forces. We have not fostered in our public schools that being a good technician can be a rewarding career. But the problem also lies within organizations that fail to train and provide tools and test equipment that are needed by their personnel and some "hands-on" experience.

Sometimes, we put the burden on those who have experience to train newcomers, who now have Associate or other degrees and are hired in at a higher rate than those who are training them. Newer technicians want everything now (higher pay, bigger profile) but don't have experience. Experience still, in my book, counts a great deal.

I agree with your analogy about being

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"close-mouthed" about strategies. However, when people start reading more of the "ads" in their field, or head-hunters find them, then they'll know what the demand is out there. Quality technicians, in my opinion, are becoming "rare."

—Dick Fay
Manager, Wireless Group, Duke University

Companies compete for technicians

Regarding technician shortage, I believe that "Viewpoint One—There is no shortage" is correct.

While our company is a manufacturer, rather than a service provider, we still use the same skill sets for our final test technicians and customer service techs as a contemporary two-way radio technician. These guys do not work on the same variety of radios that an independent shop would see, but they must be thoroughly familiar with the innards of FM and now digital radios, RF power amplifiers, duplexers, etc. and also be able to assemble these components into our point-to-point fixed radio telephone links and our trunked point-to-multipoint systems and make these systems perform to specification. Our benches have the same type of test equipment, including IFR 1200, HP 8920A and Motorola service monitors, HP and Tec scopes, as any two-way shop. We therefore compete directly with two-way

shops both in our region and nationally for talent, as do several other telecom manufacturers in our area. We advertise extensively on the Internet for technicians and hire people from all over the country.

Within the last four months, our company had to move from the rural area where we were founded ... in order to attract technical and engineering talent. Others who compete for the radio segment of this talent pool include all of the cellular service providers, PCS providers and those surprisingly numerous companies that are system integrators in the international market. Our two field technicians who travel to our customer's sites (mostly international) to install our systems and train our customers in the operation and maintenance are literally the highest-paid employees in the company, when considered on an hourly compensation basis. We compete with companies such as Motorola, Bechtel and Fluor Daniel for the talents of these experienced people.

Unfortunately this means that the talent available to many two-way shops that cannot afford to pay market wages or provide highly competitive benefits (our benefits include stock options, medical, dental and life insurance, integrated vacation and sick pay amounting to four weeks after three years of employment, and more) will not get the pick of the crop. The only solution I can suggest is to raise the

price of service, and pass this on to the employees. There is an effect of diminishing returns when doing this, as more equipment becomes unrepairable because of economics.

—Jim Longnecker
Senior Applications Engineer
Optaphone Systems

Taxpayer Identification Number

Robert Schwaninger may be speaking a little too lightly about the "Taxpayer Identification Number" (TIN) ("Regulating Technology," June 1998). This seems to be suddenly extremely important and, for some reason, has eclipsed the all-important call sign in the FCC. I suppose this is the result of some congressional legislation (oversight). I wonder what would happen to a license application, auction bid, etc. that you submitted, and it so happened you had made a mistake on a yearly submission or had something pending with the other organization concerned with "TIN."

May Robert be appointed someday kicking and screaming to the FCC, live long and continue writing his delightful column after his appointment!

—Dennis R. Murphy
Bismarck, ND

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The sound of Sam

By Robert H. Schwaninger Jr.

This is Washington, where the summer heat bounces off the pavement in steamy waves. Government workers' blue-light-special ties hang limply from sweat-soaked necks. An endless stream of secretaries lope on retro stacked-heeled shoes toward the Metro. The human mass moves along huge squat buildings that hint at the long-dead WPA, barely recognizing each other's existence until queuing for position at the deli counter or half-smoke vendor cart.

Among the eddies and streams of people are lawyers, consultants, lobbyists and media types. These denizens demonstrate the most carnivorous nature. They feed on Congress. They dine on executive decisions. They consume their own in cannibalistic frenzy. These political predators hear and smell things—indications that are missed by the untrained ears and antennae of other humans.

They hear rumblings of change, like tectonic plates moving a millimeter closer to the ocean, emanating basso echoes from the halls of Congress. They detect a high-pitched squeal, like that of a small creature before it trembles for the last time, whistling from the lifeless lips of a constituent who has been told "That's the way it is." They sense the rhythmic drone of the bureaucratic machinery pounding along, one pile-driving beat at a time.

I'm one of the predators: a lawyer. I've

been trained to see a catastrophe as a billable occurrence and devastation as opportunity. And, like a small child, I've been told again and again to look both ways before crossing the agency highways where truckloads of decisions, rules, regulations, licenses and fertilizer are carted to the nation's hinterlands.

"Don't get in the way, boy," is the admonition. Sometimes, I don't listen.

Sometimes, I'm listening to other sounds—sweet, sad sounds, that overpower the din from meeting and committee rooms. Like a cricket's song of unrequited love, the sound that I hear chirps

who's asking, "Why?" I hear it again and again. "Why?"

He might be a guy named Sam, who works in a plant down the street from the loading dock my old man spent 29 years patrolling. His damn radio won't work because he's getting interference from another operator again, and nobody's doing anything about it. Sam complains to the boss, who tells him, "They're working on it." But Sam knows that they've been working on it for over a year, and it's just getting worse.

Sam is the guy who had to take the cellular phone out of his wife's car. They can't afford it anymore, because his cable

bill keeps creeping up and up at the same time that his favorite team is switching to pay-per-view. Now he reads that he'll have to buy a new television set for something called HDTV. His set works fine. It's the world that's a little screwy.

Sam bought his kid a computer a few years ago. He had to scrimp to get it, and his wife had to wear the same dress two years in a row to the family Christmas dinner, but they figured they were doing right by the kid. Now the damn thing is obsolete and won't run the new software. The kid

claims he's the only 15-year-old on earth with something called a "386." Sam feels rotten, but a new computer costs over a grand, and the Chevy needs an overhaul.

Sam reads in the paper that his cable company just got sold for billions, and he stares at the notice in his bill that says the rates are going up again. And while he's staring down at the stack of bills on the kitchen table, he notices that he's still being charged two bucks a month for digit dialing. Sam can't remember the last time he saw a rotary phone. It was sometime



Illustration by John Hayes

and sings to my conscience, reminding me that it wasn't always like this for me. It shouldn't always be like this. I try to ignore it, or dismiss it as an unworthy distraction. But it keeps coming and coming, until I have to pay attention. I have to stop shoeing it from my mind. I have to act.

The sound I hear is the distant cry of the recipients and victims of those truckloads of regulation and decisions, made with mechanized precision on the desktops and laptops and cyberflops of the government. The sound of one guy back in Missouri

Schwaninger, MRT's regulatory consultant, is a partner in the law firm of Brown and Schwaninger, Washington. He is a member of the Radio Club of America.



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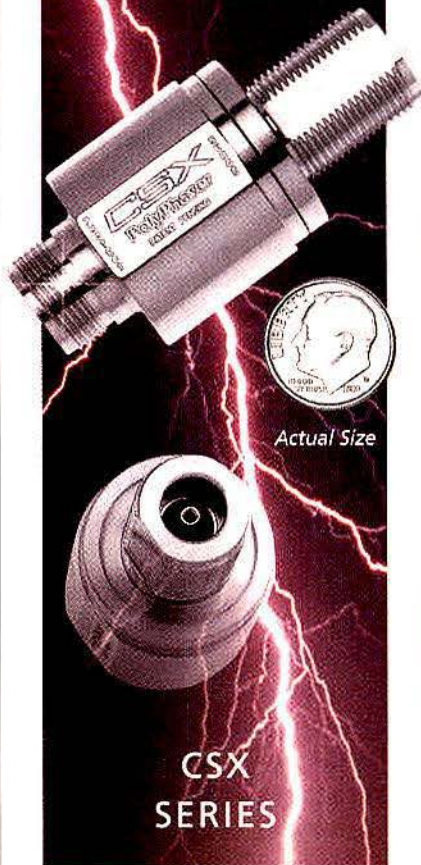
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before the phone company told him he was now the owner of his home telephone equipment and the wiring in his house. He remembers he wasn't sure what that meant, but Sam kept that secret to himself.

Aunt Martha's birthday card ticked him off. The wife forgot to tell her that the area code has changed, and Aunt Martha didn't know how to get the new one. She's over 80, you see, and talking to telephonic menus is simply too foreign, too new. Aunt Martha doesn't know from LATAs. She has never surfed the 'Net or received email or seen "The X-Files." But she makes the best strawberry-rhubarb pie in Pella, IA.

Sam rakes his calloused fingers through his thinning hair and stares out the window. A long, dejected sigh rushes from Sam's lips, with a sound like dusty air from a bellows at the bottom of a cave, that only a tear could punctuate. At the end, Sam asks in a small voice, "Why?"

That's the sound I hear—the one that keeps nagging me, berating me, making me do things, write things, say things that cause my fellow capital carnivores to look sideways and shake their heads. Like a milliwatt into a preamp and out a high-

**Why doesn't the
FCC care whether
Sam's radio works?**

gain antenna, I repeat Sam's question loud as I can. I shout it with the power of overused lungs. "WHY?!"

Why doesn't the FCC care whether Sam's radio works? Why does Congress allow the telephone companies to charge for a "new technology" that has been in the market for over 20 years? Why do cable rates continue to rise with impunity? Why are computer manufacturers allowed to make two-year-old models obsolete?

Why can't you go down to the phone company and sit across the desk from someone who will discuss your bill and answer your questions? Why, with every newfangled device, does the price for service seem to go up and up for features that Sam can't use—and wouldn't buy if he had a choice?

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Optimizing performance and maximizing capacity in CDMA systems

By Andrew Singer

Several techniques can improve the performance and capacity of CDMA systems. RF engineers now realize that CDMA offers an opportunity to trade off capacity, coverage and call quality.

As PCS carriers operating code-division multiple-access (CDMA) systems finish deploying their phase-one "build-outs," they move to the *optimization* stage. Optimization is a critical stage that can significantly affect the performance and capacity of a CDMA system. Several techniques can be used to optimize CDMA system performance during this critical stage.

One of the easiest methods of "stealing" system capacity is to have too large of a *soft hand-off zone*. "Soft hand-off"

is a state where the mobile is in communication with *multiple base stations* at the same time. "Softer" hand-off is when the mobile is in communication with *multiple sectors* of the same cell. A link is established with a target cell before the link with the currently serving cell is broken. CDMA gains several advantages by employing soft hand-off: fewer calls are dropped, less portable transmit power is required and less interference is experienced. However, as in many cases, too much of a good thing can hurt you. If the soft hand-off zone is too large, the system will have less capacity because two base stations are carrying the same call during soft hand-off, as shown in Figure 1, below. Soft hand-off is a compromise between system performance and system capacity. Greater soft hand-off usually improves performance, but it decreases capacity. The ideal amount of soft hand-off is about 25% to 40%. The need for minimized overlap between sectors is one of the reasons that CDMA operators are deploying 65° and 90° horizontal beamwidth antennas instead of the traditional 105° and 120° horizontal beamwidth antennas used in AMPS cellular. An operator must also ensure that the T_ADD, T_DROP and T_TDROP parameters are set correctly for optimum performance.

The RF engineer must be careful when making this critical decision regarding the use of narrower horizontal beamwidths. Although the trend has been toward narrower beamwidth antennas, with excellent results, there are exceptions. One operator deployed 80° horizontal beamwidth antennas on a few relatively high sites with disappointing results. In that application, there were significant "notches" in the coverage area between sectors. A general rule is that as tower heights increase and site radius widens, horizontal beamwidth will need to widen. Many operators are deploying 90° horizontal beamwidths for their CDMA sites, and some operators are using 65° horizontal beam-

Singer is director of technical marketing for Celwave, Marlboro, NJ. He is a member of the Radio Club of America.

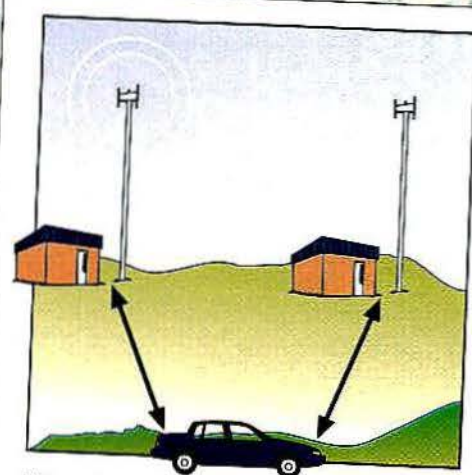


Figure 1. While the mobile unit is in the soft hand-off zone, both cells are active.

widths, particularly for dense urban areas.

Another important aspect of the horizontal pattern is the H-plane "roll-off." The more rapid the power roll-off beyond the 3dB beamwidth points, the higher the sectorization efficiency. If you overlay various antennas with the same 3dB beamwidths, you can observe that two or more antennas can have the same 3dB beamwidth, but some will roll off quicker beyond the 3dB points.

One last feature to look at in horizontal patterns for CDMA systems is high front-to-back ratios. The higher the front-to-back ratio, the less likely co-channel interference will be an issue off the back of the sector.

Another optimization method is to minimize areas suffering *pilot pollution*. Pilot signals act as beacons to notify potential users of the existence of a CDMA base station. Portables use the pilots for power strength comparison, which is essential for the process of a hand-off. The pilot signal is the strongest channel, containing 20% of the total radiated power in a CDMA signal. Each CDMA sector sends its own pilot signal, but they are all on the same frequency.

The portables in use today have a four-finger "rake" receiver. One finger is used to scan for pilots and the other three can "listen" for pilots. If a portable is in a location where numerous pilots are received with relatively

equal signal strength, the result is pilot pollution.

Pilot pollution can cause dropped calls and decreased capacity. Drive testing in these areas will show a noticeable problem with frame-error rate. To avoid pilot pollution, operators can use antenna downtilt¹, azimuth rotation and careful horizontal beamwidth selection. Some carriers in core urban areas have been using 33° sector antennas to minimize pilot pollution, as shown in Figure 2 at the right. Often, these antennas are used at sites located on bridges because signals propagate significantly greater distances over water.

Other methods of reducing pilot pollution used less extensively include lowering cell site heights, lowering cell site power and using repeaters. One method of battling pilot pollution is to ensure that one cell has a dominant pilot. This can be done by using a repeater to saturate a small area with one particular pilot. These are tools that the RF engineer can keep in his "tool box" for solving pilot pollution issues.

Some CDMA operators use continuously adjustable electrical downtilt antennas to minimize pilot pollution. When antennas are me-

¹Singer, Andrew, "Selecting Antennas for PCS and DCS Systems," *Mobile Radio Technology*, July 1997.

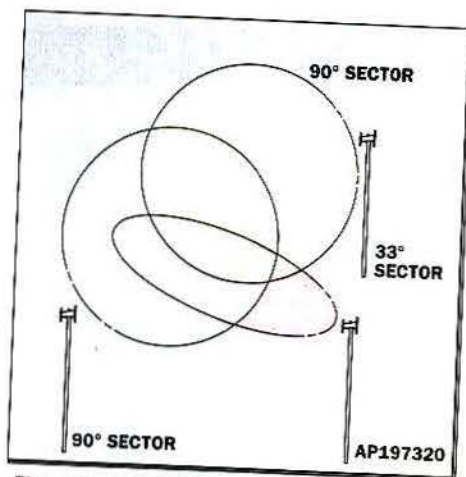


Figure 2. Use of 33° sector antennas to minimize pilot pollution.

chanically downtilted, the energy off to the sides of the antenna is not reduced on the horizon, and this energy can cause pilot pollution at nearby sites. Electrically downtilting the antennas reduces the energy on the horizon both in front of the antenna and on the sides. In situations where pilot pollution is caused from the side radiation of a nearby site, a continuously adjustable downtilt antenna can be adjusted while performing drive tests after each adjustment, to optimize the system for coverage and reduction of pilot pollution.

Continued on page 22

Some Criteria for Evaluating Antennas

By Dwight Staehler

Complaints about high reflected power, high VSWR or poor match all mean the same thing. The antenna does not appear to be absorbing as much power from the transmitter as it should. It must be determined whether the installation or the product is the cause. Answers to the following technical questions can help determine if the product qualifies as defective per the manufacturer's warranty. (This presumes all connections are clean, dry and tight and that all test equipment is in good condition and properly calibrated.)

1. What is the VSWR you measured?

Check to see if it is a higher number than the catalog value for this product. For example, many antennas have a match of 1.5:1 or 1.6:1 across a specified bandwidth. Performance at a VSWR greater than 2.0:1 may be unsatisfactory. Some technicians will refer to match as "return loss," in which case rates of 14dB or 12dB apply. Performance at a return loss of less than 9dB may be unsatisfactory.

2. What test equipment did you use?

Check to see that the equipment has been properly calibrated and that any connector adapters are of good quality. A poorly matched adapter will invalidate the results.

► **Wattmeter/power meter** — These devices are inexpensive, and therefore, more common, but they can be inaccurate, particularly if more than one RF carrier signal is present. Technicians who use wattmeters and power meters will eagerly tell you how many watts of power is reflected back to the transmitter, but often they do not know the actual mismatch. The forward power measure-

ment is required to calculate the VSWR or return loss number. This can be tricky because some transmitters have an output stage protection circuit that reduces power under highly reflective conditions.

► **Network analyzer/spectrum analyzer with tracking generator** — These devices do not rely on the site's transmitter as a signal source. They can produce more accurate and meaningful results, but they do not subject the antenna to full power, when arcing or flashover would occur.

► **Time domain reflectometer** — Occasionally, a technician will use a TDR. This is not an industry-recognized instrument for antenna testing, and many manufacturers will not respond to these measurements because they do not use RF and do not measure beyond bandlimiting devices.¹

3. Did you perform the measurement directly at the antenna's connector?

The technician may have chosen not to perform this test because it requires climbing the tower. This procedure should be done to eliminate jumper cable or download cable factors. The cables could be defective and causing the problem. They could also be fine, but they could be absorbing the reflection that masks the problem.

4. What is your operational frequency?

Check to see if the antenna was ordered for the correct frequency. The manufacturer may have mismarked the antenna or carton. Several methods can determine an antenna's frequency. If the technician has swept the response of the antenna, he will know

Continued on page 20

Staehler is an applications engineer for Celwave, Marlboro, NJ.

¹Dong, Cynthia, "Identifying Transmission Line Faults," *Microwave & RF Communications Products*, Nov./Dec. 1996.



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CRITERIA

Continued from page 19

the frequency of the best match. That should be its *designed* frequency. The technician can also measure the physical length and compare it to a cut chart. This is a crude method. If the antenna is relatively new and the model number is known, the factory may still have the production test data sheet that will identify its frequency by serial number.

5. Did you measure the antenna erect, free and clear of metal objects?

Side mounting too close to the tower can detune an antenna. The required spacing distance between the antenna and any other metal object decreases as the operational frequency increases. Some good numbers per our factory test procedure for omnidirectional antennas are from 100 feet at 30MHz to five feet at 900MHz.

6. What is the dc continuity, as measured with an ohmmeter?

Some antennas have direct ground lightning protection. These normally measure as a dc short between the connector's inner and outer conductor but will be the proper 50Ω impedance at RF. See "lightning notes" in catalog specifications to determine if the antenna will measure as an open or a short.

7. Did you have the opportunity to substitute an identical antenna?

If the second antenna measures OK under the same mounting conditions, the technician's first antenna is probably defective. If the second one yields the same bad result, the problem is unlikely to be the antenna. Perhaps the transmitter is not operating on the expected frequency.

8. When was the antenna installed?

It could either be new and defective or one that had performed nominally for some time before failing. It is a good practice for technicians to test products on receipt before transporting them to the job site. Manufacturers' warranties cover only manufacturing defects, not damage from an improper installation. An example would be mounting a standard antenna upside-down. This would put the drain hole at the top, where it could collect water and cause the product to fail over time. Factory options given to an inverted antenna include reconfiguring both the drain hole location and any electrical beam tilt.

9. Are the antenna drain holes open?

They are placed at the bottom of the antenna for draining internal moisture. Periodic inspection of these openings is the responsibility of the owner. They must remain clear of debris to preclude corrosion from internal condensation. Such damage can drastically affect performance, and it is not covered by warranty.

10. Is the antenna intermittent?

It is a good idea to shake the antenna during the above tests to ensure there are no mechanical intermittents. Poor connections may lead to RF intermodulation products. Water entering the antenna may lead to electrical intermittents that subside when the antenna dries out.

Match is only one indicator of antenna quality. VSWR tells us how well the product's impedance matches to (absorbs) a transmitter's signal, and it is easy to measure in the field. Unfortunately, VSWR does not reveal an antenna's *efficiency* (how well it radiates the signal). This measurement (an antenna's *radiation pattern*) is more difficult to perform in the field. We may presume that match bandwidth and pattern bandwidth are equal, but this is not always true. For example, operating an end-fed antenna below its design frequency will result in an electrically downtilted vertical pattern. Usually, substitution with an identical unit of known quality is the method of choice when a defective product is suspected.

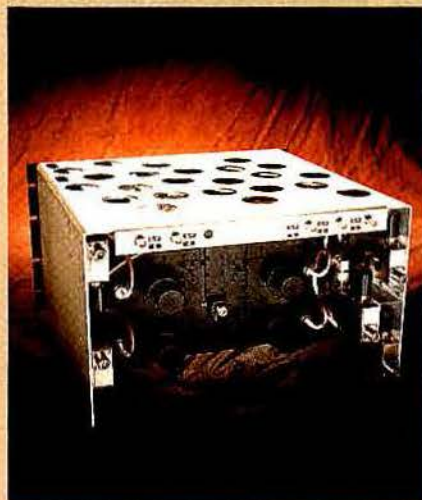
The typical VSWR for a good antenna is 1.5:1. Although some site engineers may specify a minimum acceptable value of 1.3:1, there is only a miniscule improvement. For example, at a 1.5:1 ratio, 4.0% of the power is reflected back, creating a 0.18dB loss. At a 1.3:1 ratio, 1.7% is reflected, resulting in 0.07dB loss. The performance improvement is only 0.11dB.

It is a good idea to document performance upon installation. This is usually done by choosing a remote site and measuring the signal level received from the transmitter. Periodic measurements at that same location will reveal the amount of any degradation so that corrective action may be taken. ■

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One often-ignored method of optimizing CDMA systems is tweaking the *neighbor list*. An operator needs to avoid a hand-off to a sector that may only temporarily provide good coverage, such as the high site shown in Figure 3 at the right. Tweaking the neighbor list allows the portable to be instructed as to which neighbors to search first for a good hand-off. If the portable hands off to the wrong sites, the call can be dropped, and capacity will be wasted as well. The neighbor list needs to be updated as new system sites are added.

One final method of optimization is to ensure that your antenna system is minimizing the addition of noise and interference into your CDMA system. Noise and interference can significantly limit your system's capacity. *Antenna intermodulation* is one form of this noise and interference. Make sure that your system's antennas are designed robustly enough that their intermodulation (IM) performance does not decrease with time. The IM performance of designs using multiple cables and solder joints are susceptible to deterioration once the antennas are placed in an outdoor environment. Many antennas do not even meet their advertised IM specifica-

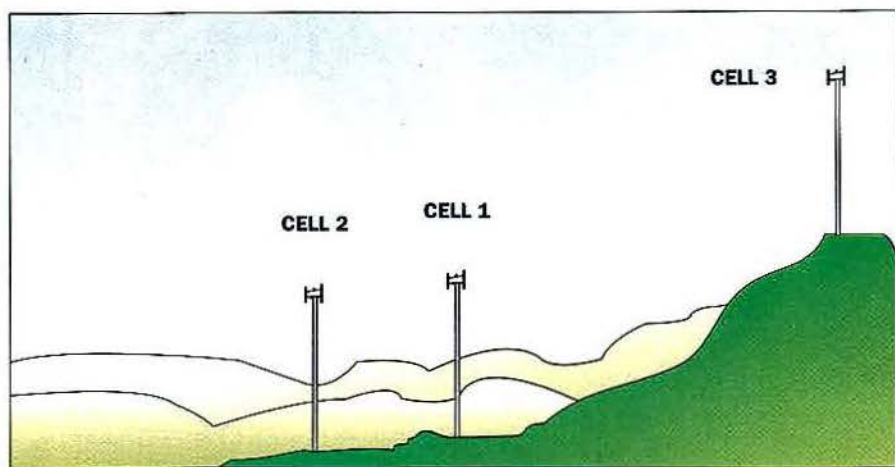


Figure 3. Cell 3 should not be on the neighbor list, but Cell 2 should be.

tion before being placed on a site.

Antennas that use PC boards can also add a noticeable amount of noise to the system. For instance, if the PC board used in the antenna has a distributed loss of 2dB, this is the same (from a system noise standpoint) as adding a 2dB attenuator pad to the input of the antenna. This 2dB of loss will also improve the VSWR of the antenna, but for the wrong reasons. Remember, a 50Ω load can have a great match, but all the power is absorbed as heat. An operator needs to keep in mind that any losses in the antenna, such as

lossy PC board material, will negatively affect the receiver sensitivity.

Operators also need to understand the compromises and potential negative impact of using polarization diversity in a system.²

There are many methods for improving the performance and capacity of CDMA systems. RF engineers realize that CDMA offers us an opportunity to trade off capacity, coverage and call quality. ■

²Singer, Andrew. "Improving System Performance." *Wireless Review*, Feb. 1, 1998.

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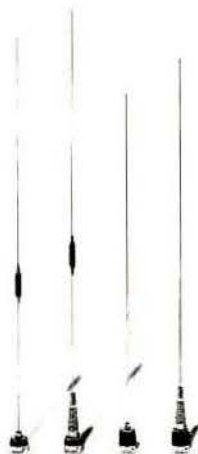
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Voice quality in PCS and cellular networks: Eliminating echo

Improvements in digital mobile communications technology can actually aggravate problems, such as echo, that are unnoticeable in analog systems. The use of echo cancelers is one way to improve voice quality.

By Doug Stuard

Wireless customers want their phones to sound as good as their landline phones. To meet this demand for "toll-quality" sound, service providers must increase voice quality throughout their systems. Changing from analog to digital modulation dramatically improved voice quality by reducing the noise associated with analog air interfaces. Digital systems, however, introduced circuit delays that made acoustic echo seem more prominent.

Some network providers have taken steps to resolve acoustic echo. Diligence is

necessary because additional mobile network improvements that reduce noise even more will unmask lower levels of acoustic echo.

Echo Sources

In a typical wireless-to-wireline phone call in a PCS or digital cellular system (that is, from a wireless phone to a PSTN phone), two types of echo exist. *Hybrid echo* on the public switched telephone network (PSTN) end of the phone call is caused by the electronic reflection resulting from the four-wire to two-wire impedance mismatch. (See Figure 1 on page 26.) For echo to be noticeable, the human ear

must detect some delay between the source signal (in this case, the spoken word) and the echo signal. In typical local-loop applications, this echo is not noticeable because the delay is so short that the human ear does not separate the original speech from the echo. Typical long-distance applications induce delay primarily through propagation, and thus they require hybrid echo cancelers for correct operation.

In a PCS network, however, propagation is a secondary issue because processing delay is always introduced into the

Stuard is the product manager at Tellabs, Ashburn, VA.

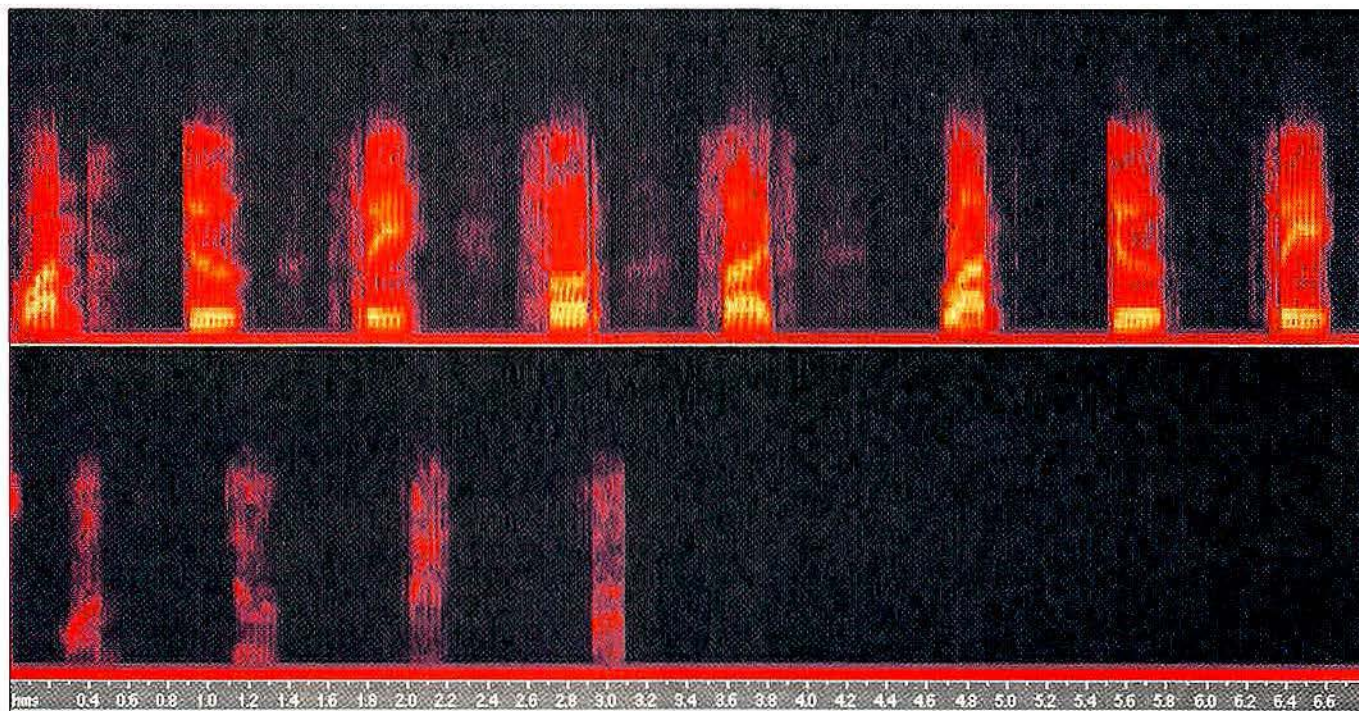


Photo 1. Voice prints reveal wireless and wireline echo without and with cancellation.

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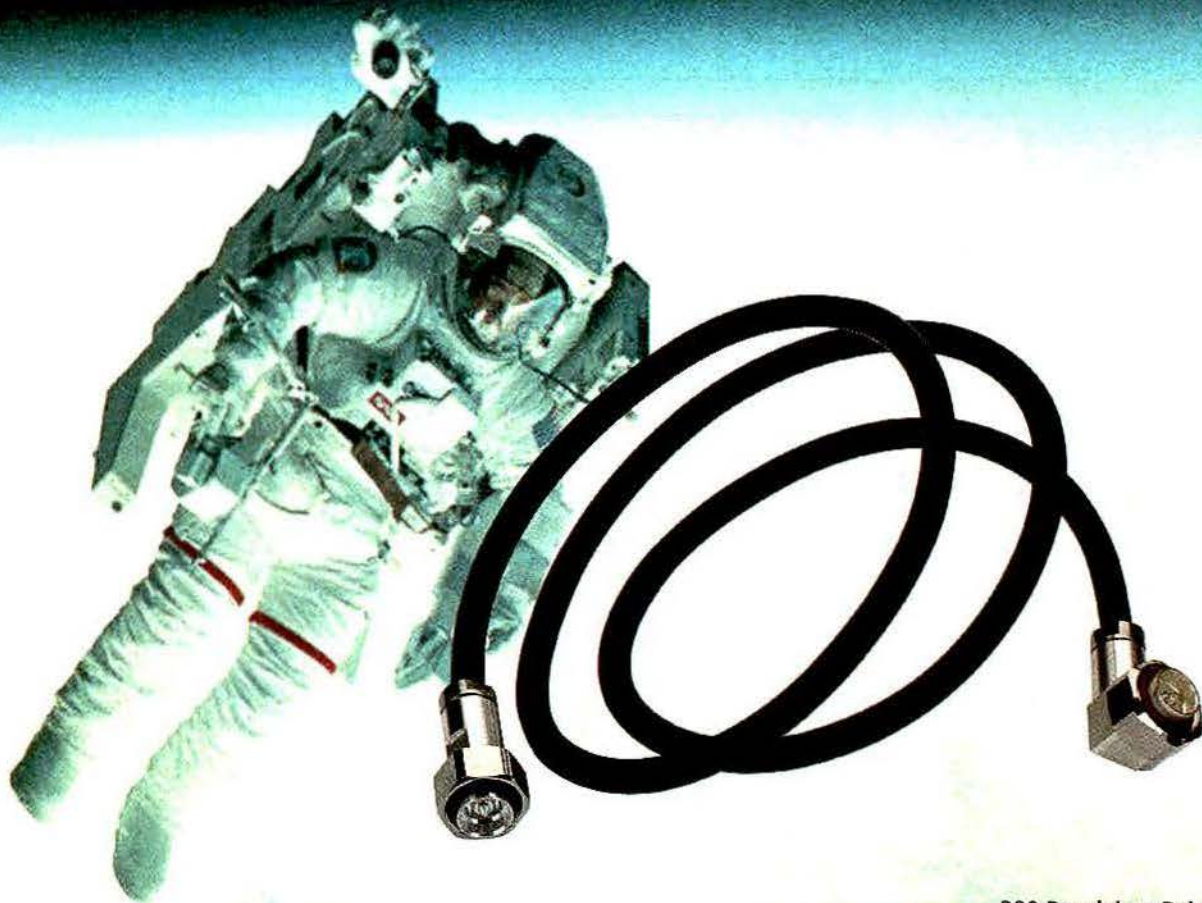
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propagation path through the network. This delay is reduced or eliminated in the mobile network, typically at the mobile switching center (MSC), according to GSM specifications that require cancellation "looking toward" the PSTN.

The International Telecommunications Union's (ITU) Recommendation ITU-T G.168 ("Digital Network Echo Cancelers") specifies the performance of echo cancelers and the test conditions for verifying performance in the PSTN. In wireless standards work, the GSM standards, as noted above, deal explicitly with hybrid echo cancellation.

Acoustic echo

The other previously mentioned echo phenomenon, *acoustic echo*, has become apparent in wireless networks.

Acoustic echo is defined as the coupling of received voice transmission between the earpiece and mouthpiece of a portable handset or the speaker and microphone of a hands-free mobile phone. When acoustic echo occurs, it is the PSTN user who is discomforted. (For simplicity, this discussion will refer to a wireless user and a PSTN user, even though the general case could include two wireless users.)

Acoustic echo is a much more complex signal than hybrid echo. The simple case of a

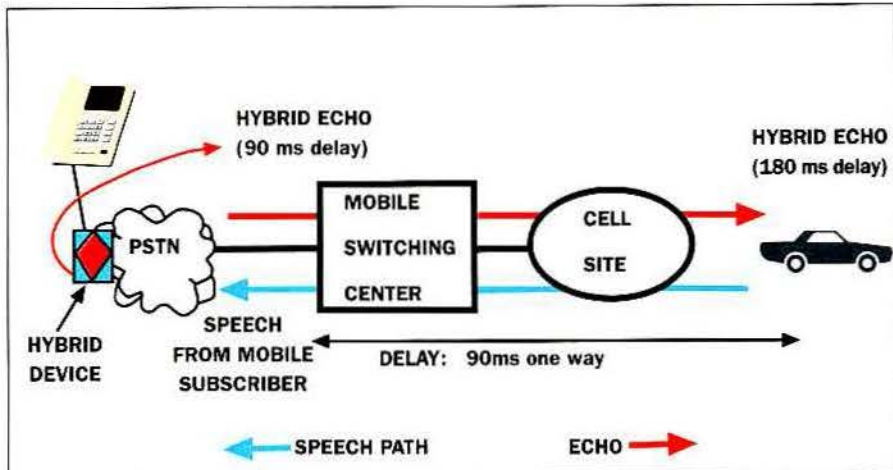


Figure 1. Hybrid echo in a wireless-to-wireline call.

hands-free mobile phone illustrates the example most clearly. The received signal emits from the speaker and reflects from multiple surfaces inside an automobile. The reflections return the signal, at various time delays and amplitudes, into the microphone, and over the phone connection to the PSTN user's ear. In addition, the tail circuit is non-linear because of the speech compression. Because these reflected signals are typically delayed 180ms or more, the PSTN user hears a perceptible echo.

Portable handsets couple the PSTN user's voice between the earpiece and mouth-

piece, as shown in Figure 2 on page 28. This occurs either directly, as handsets get smaller, via reflections off the user; or via reflections from the environment. This coupling is more prominent when the wireless user increases the handset volume, to compensate for high background noise and for PSTN users with soft voices.

Handset specification

GSM specifiers did not ignore acoustic echo when developing standards. As with any echo, the closer to the source it is dealt

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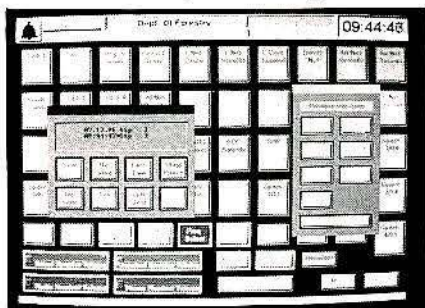
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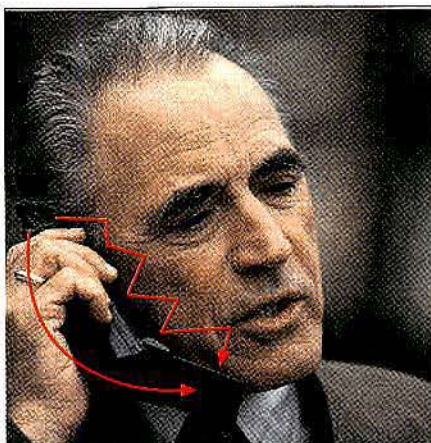


Figure 2. Handset acoustic echo paths can be formed by reflections off of the user.

with, the more effective the solution. For acoustic echo, the source is the handset. Two aspects of handset specifications deal with echo loss performance characteristics. One is the *handset performance*, and the other is *testing specifications*. The weighted terminal coupling loss (TCLw) value of 46dB, derived from ITU's Recommendation ITU-T G.131 ("Control of Talker Echo"), is the specified performance characteristic for handset acoustic echo return loss (AERL). This level, as evidenced by continuing discussions among the European Telecommunications Standards Institute's (ETSI) special mobile groups, is not universally accepted as being correct or indicative of operational conditions across the voice bandwidth.

GSM Phase I testing methods are flawed, in that sinusoidal tone testing is allowed to be run through the speech coder/decoder (codec) to verify performance. The full-rate codecs cause sinusoidal spreading, which results in lower power when measured at discrete frequencies. Testing that bypasses the codec, as allowed by the specifications, is also flawed, because it precludes an element that degrades the GSM system. Both test approaches result in equipment that displays artificially high AERL levels that allow acoustic echo to leak through.

Phase II specifications are intended to improve this performance via an artificial voice test stimulus as specified by ITU's Recommendation ITU-T P.50 ("Artificial Voices"). In conjunction with a proposed head-and-torso simulator (HATS) that incorporates free-air transmission, these test methods would attempt to more closely represent actual user conditions. There is still

resistance to this approach, so the main improvement in testing in Phase II is expected to be the more indicative stimuli.

The effect of improved coders

Attempts to increase GSM system voice quality have resulted in extensive study and proposed alternate coding techniques. The enhanced full-rate (EFR) coder concept was put forward to improve the quality without imposing a penalty on bandwidth. The U.S.I. codec, adopted by ETSI, provides improved performance over the full-rate coder while using the full-rate codec, thus making deployment easier. The comparative quality is shown on a mean-opinion score (MOS) scale in Figure 3 on page 30. The graph shows statistically significant performance improvement in error-free conditions (EP0) through carrier-to-interference (C/I) conditions of as much as 7dB (EP2).

So where's the problem?

Improved quality from the processing within the coding stage diminishes the masking of acoustic echo produced by the mobile handset. EFR coding, for instance, improves the channel's performance but allows acoustic echo to be detected by the user. Mobile users are prone to increase their volume levels to overcome local background noise, exacerbating the acoustic echo problem by increasing the likelihood of coupling.

Echo cancellation

To solve this problem, many carriers limited the level of the mobile user. This decreases the acoustic coupling, but the subscribers (who are paying the bills) cannot hear the PSTN-side user. Another solution is

to use echo suppressers in the switching equipment. Many manufacturers integrate suppressers into their systems, but the performance of these devices is limited, particularly with double-talk. (See "Echo cancel-

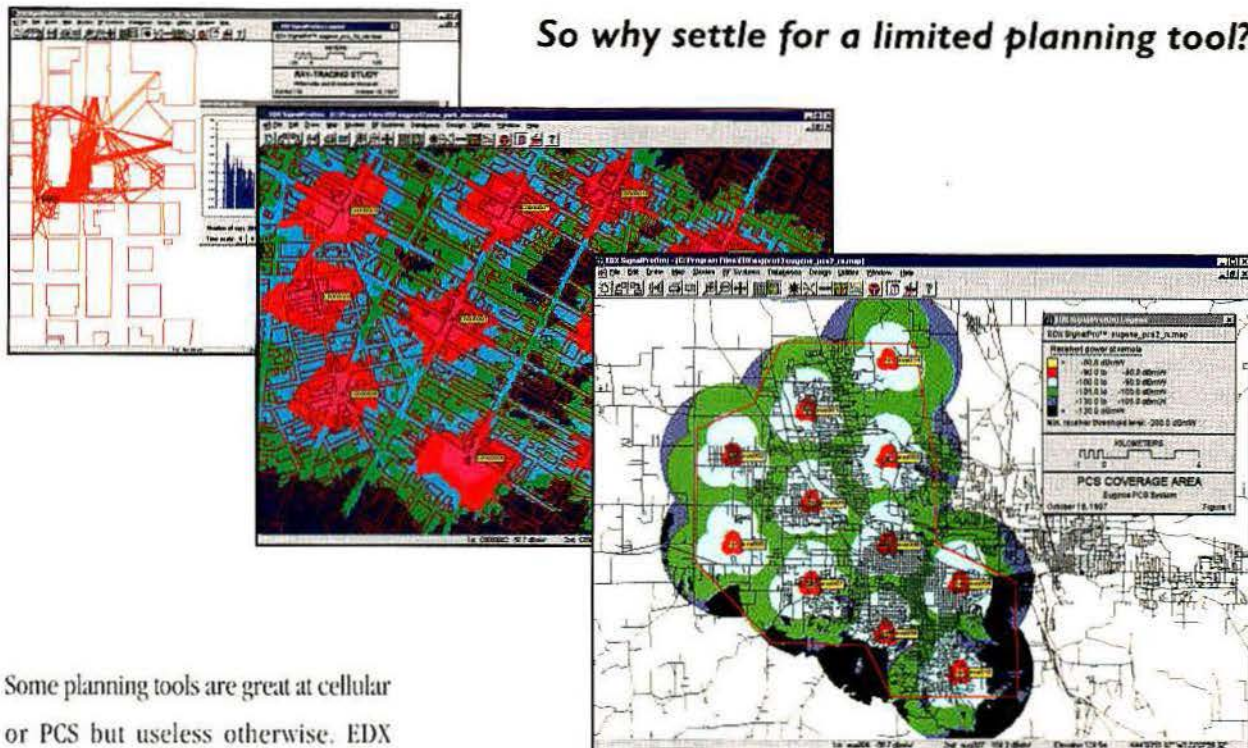
ing vs. echo suppression" on page 32.) The ideal solution to acoustic echo is the use of high-quality echo cancelers.

To be effective in a wireless environment, echo cancelers need critical features including effective, bidirectional, acoustic and hybrid echo cancellation. They must also be able to tune the tail circuit delay offset. Finally, they must be compact and support future audio-enhancing signal processing capabilities.

**Testing that bypasses
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Effective acoustic echo canceling in digital wireless networks requires a different approach from conventional hybrid echo canceling because of the non-linear tail circuit. The implementation must account for these non-linearities and must remain stable upon convergence to provide seamless canceling. For echo canceling to be effective in this mode requires the significant processing capacity of a network processing canceler when in the presence of low-performance handsets.

Traditional echo cancelers are limited to 128ms tail lengths, largely due to cost. Processing delays in the tail circuit (between the MSC and the handset) of a mobile system will result in tail lengths approaching 300ms. To cancel effectively, a 64ms canceler needs to anticipate the non-linearity associated with this additional delay and cancel the echo where the reflections are most prominent. Initial convergence accounting for this tail circuit property will result in a more stable system. Photo 1 on page 24 shows voice prints of echo without and with cancelation.

Architecturally, ideal use of space in the MSC for an acoustic canceler would result from the use of a canceler that looks both *into* the wireless end and *out* at the PSTN end, in a single canceler package. Photo 2 on page 32 shows one such canceler. The alternative (independent cancelers that are wired back-

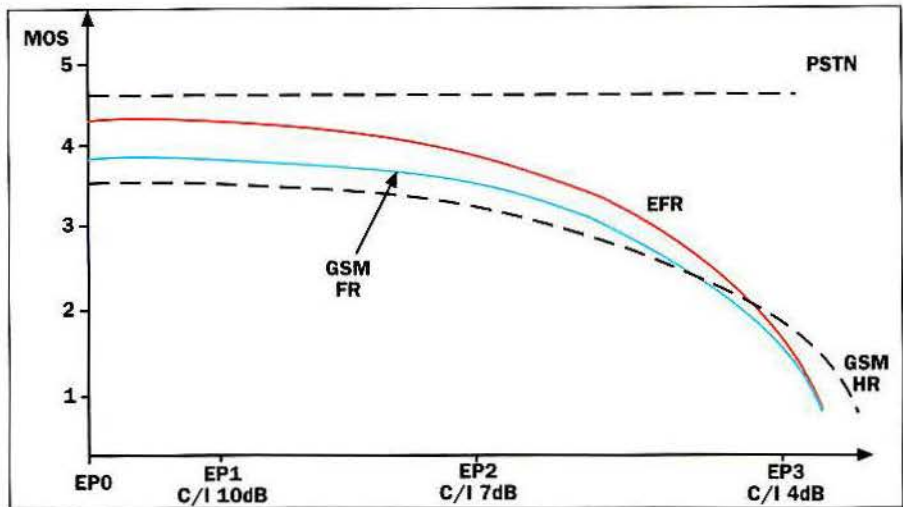


Figure 3. The graph shows the relative speech performance of GSM speech coders.

to-back), requires additional money, space and power. Because of the unpredictability of the handset's AERL capabilities and the variability of the caller environment, it is impractical to place a canceler in the circuit only when conditions require it.

Conclusion

Voice quality problems, particularly those attributable to handsets, reflect poorly on overall network quality. The ideal solution, stricter governance of handsets, is imprac-

tical both from an economic and technical perspective. The handset marketplace demands small size, high fidelity and low prices. Implementation of sophisticated processing to solve acoustic echo problems at this level is not likely because it would adversely affect handset size, weight and cost. From a technical point of view, specifying and testing handsets in many and varied environmental conditions with realistic test conditions and stimuli have been resisted to date.

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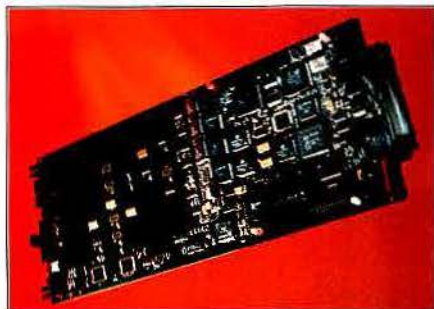


Photo 2. A Bidirectional echo canceler board.

It falls to network providers to implement solutions that deliver better voice quality to their customers. State-of-the-art acoustic or bidirectional hybrid and acoustic echo cancelers can provide that support today to wireless networks worldwide. ■

References

- "Analysis of Noise Sources when Measuring Echo Loss of GSM-Mobiles with the GSM-Test System," Special Mobile Group 7, European Telecommunications Standards Institute, Sophia Antipolis, France, TDoc SMG7 448/97.
- "Artificial Voices," ITU-T Recommendation P.50, International Telecommunications Union, Geneva, 1993.
- "Control of Talker Echo," ITU-T Recommendation G.131, International Telecommunications Union, Geneva, 1996.

Echo canceling vs. echo suppression

Have you ever been on a speaker-phone conference call where you couldn't get a word in edgewise? The problem may not be long-winded associates—it's probably an echo suppressor.

Echo suppressors are commonly used in telephony for providing cheap, effective echo control. Simply put, an echo suppressor is a one-way attenuator that is activated when speech (or paper rustling or other high background noise) is detected on the transmit side. The major drawback of an echo suppressor is that it blocks transmission in one direction while the other direction is active.

Echo cancelers use a more user-friendly approach to echo control. The

echo canceler characterizes the tail circuit impulse response and applies a sophisticated subtraction algorithm to the return path, which removes a significant amount of echo. Any remaining (residual) echo is then further processed by the non-linear processor, which performs complex attenuation of that residual echo.

Incorporated into many echo cancelers is the ability to inject comfort noise. In fact, many new echo cancelers have noise injection capabilities that provide background noise matching, which further enhances the aural comfort.

As for that interminable speaker? Because only very low-level residual echo is attenuated, you can make your point—and he will hear you.

"Digital Network Echo Cancelers," ITU-T Recommendation G.168, International Telecommunications Union, Geneva, 1997.

Goetz, I., "Opportunities for Improving the Speech Quality of Digital Cellular Systems," DMR VII Conference, October 1996.

"Liaison Statement—Problem with Echo Loss Testing," Special Mobile Group 7, European

Telecommunications Standards Institute, Sophia Antipolis, France, TDoc SMG7 553/97.

Mehrotra, A., "GSM System Engineering," Artech House, Boston, 1997.

"Problem with Echo Loss Testing," Special Mobile Group 11, European Telecommunications Standards Institute, Sophia Antipolis, France, TDoc SMG11 30/98.

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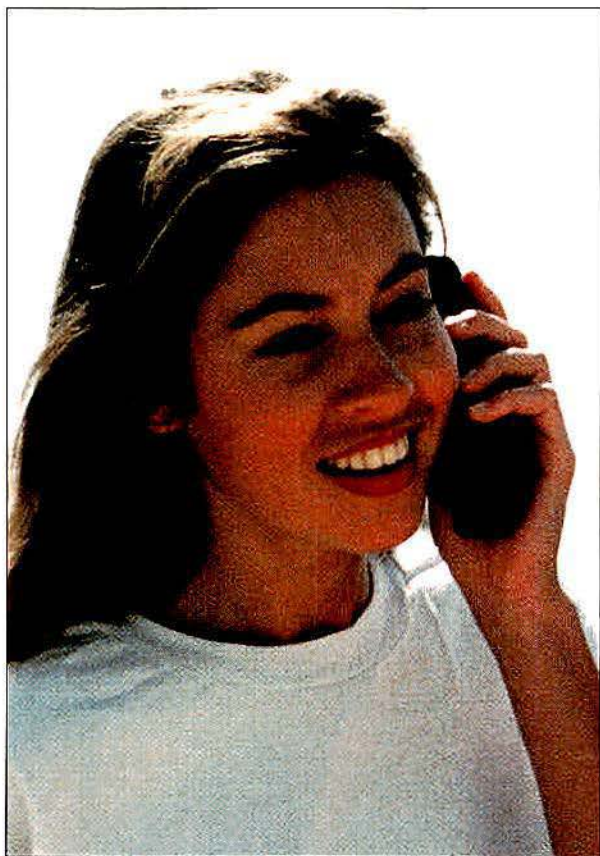
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PCS: A threat to SMR?



Will hungry, start-up, PCS companies gobble up SMR customer bases by offering multiple services? The smart SMR operator will see an immediate opportunity in many market areas—particularly in one area not usually seen as a potential for radio system owners.

By Donald E. Kochler

Rapid changes in recent years within the communications industry have some SMR business owners looking over their shoulder at increased competition. That competition was first expected to come, at least potentially, from major telecommunication providers. However, changes in federal regulations and within the telecommunications industry may have created more opportunities for SMR system operators than competitors—at least in some markets. Here is a quick look at some key history and recent regulatory changes, their effects on the industry and po-

tential new opportunities for SMR system operators.

Prior to 1974, the Bell system owned or operated most of the mobile telephone service market. The LMR systems in service were owned by the user/operator/licensee. When Congress created the specialized mobile radio (SMR) service in 1974, the new service (and spectrum) was divided to keep telephony providers and more conventional radio service providers well apart in the realm of business competition. The cellular and SMR services were created to serve different groups of users, to create opportunity for new business growth and to reduce the cost of dispatch-type services for small business op-

erations. The key difference was the classification of the SMR operator as "private" and the cellular operator as "common" carriers, with different levels of federal and state regulation and oversight.

The success of SMR trunking systems led the FCC to change the rules in 1982 and again in 1983, opening the way for services such as wide-area paging and the use of new frequency bands by private carriers. The growth and success of both services indicates how well the business community was served

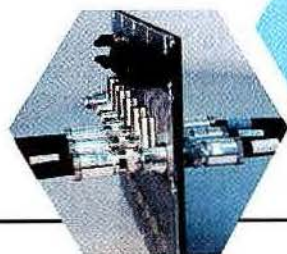
Kochler, a communications technician, teaches at the University of Alaska, Anchorage. His email address is afdek@uaa.alaska.edu.

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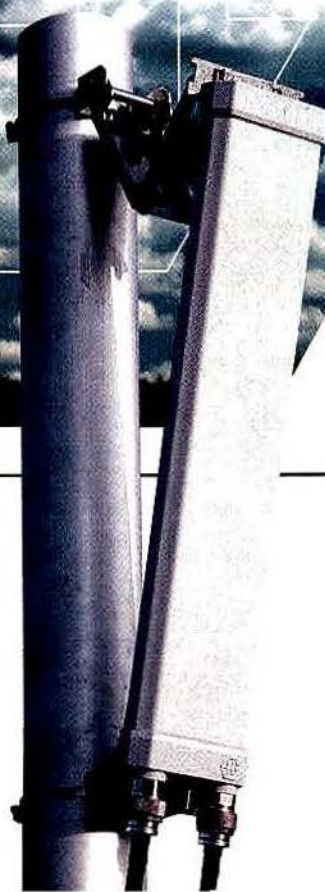
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by the changes. Today, almost 80% of SMR subscribers use the service for their business dispatch needs.

This change within the communications (radio) industry was, in some ways, almost invisible to the general public. At the same time, greater changes were altering the landscape for telecommunications (wireline) providers. The breakup of the Bell operating system into regional bell operating companies (RBOCs) in 1984, and the growth of companies such as MCI and Sprint, forever changed how people would communicate. What effect did these changes have on SMR operators? Little, until 1993.

By 1993, changes in technology, marketplace conditions and delivery of interconnection service had been described as a "technology convergence." This blurring of service and technology was a driving force behind the amendment of the Communications Act of 1934 and the reclassification of all land mobile services as either private mobile radio service (PMRS) or as commercial mobile radio service (CMRS). At once, all operators that provided third-party interconnection to the public switched telephone network (PSTN) were classified as "common carriers" and were regulated as such. If that wasn't enough, the personal communications

service (PCS) was created. Not much occurred with PCS initially, as technology choice issues, similar to those faced by the infant SMR industry, slowed growth.

The stalemate was broken, in part, when the telecommunications industry was hit with another major change in 1996. Now local exchange carriers (LECs) were allowed to offer long distance connections, and inter-exchange carriers (IXCs) could enter the local access market. This change, coupled with spectrum auctions and the high prices paid for that spectrum, had observers in the SMR industry worried. Would hungry, start-up, PCS companies gobble up SMR customer bases by offering multiple services? Could SMRs compete with huge, rich, RBOC-run systems, or would the RBOCs simply purchase existing SMR systems under the new rules?

The complete fallout has yet to be determined, but the smart SMR operator will see some immediate opportunities. One lies in the wireless replacement of the traditional copper "local loop" for the new competitive local exchange carrier (C-LEC) providers in local communities, especially in areas with low population density. Not all PCS license holders want to compete head-to-head with established cellular providers and limit their use of PCS technology to a single-service delivery system.

As new C-LEC providers start operations, they face several choices for access to their potential customer base. First, they could lease this access from the incumbent local exchange carrier (I-LEC) in the form of the embedded, copper-based, outside plant. This is a large monthly cost to a start-up company, and most I-LECs have fought tooth-and-nail to avoid leasing. Issues over interconnection standards, methods of interconnection, maintenance costs and right-of-way concerns further cloud the issue.

Second, a new C-LEC could build its own outside plant, but regulators frown on this, unless transmission is through fiber-optic cable or a combination of fiber-optic and coaxial cable (hybrid fiber-coax) that offers large bandwidth capacity to the customer. Even if this is considered, the cost to bring service to customers demands a high-density potential customer base and a desire to offer multiple services such as telephony, Internet access, entertainment or security. Right-of-way issues can still cause problems.

Third, a new C-LEC could purchase a PCS license and build a wireless system to provide local access. In many markets, many start-up companies choose to do this. Unfortunately, the auction process forced the price of spectrum so high that many companies could not fund both the cost of new equipment and a license. Further complications in the form of competing PCS technologies (GSM, TDMA, CDMA, PACS and others) can slow the

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growth of new C-LEC providers. Why? Until this technology issue settles out, many business customers are reluctant to purchase new subscriber equipment or services—especially if they travel extensively and require roaming support.

Where does this leave the SMR provider? New C-LEC providers might find SMR-based local access attractive, especially for areas with low customer density. It also offers a quick way to ramp up their cash flow with new customers, if the I-LEC has been extremely recalcitrant on local access wholesale leasing.

What is the payback to the system operator? The potential in partnering with a new C-LEC could provide significantly reduced interconnection charges, access to new customers, and the opportunity for enough new traffic revenue to support new growth or equipment in the system. Even a simple reselling agreement (wholesale) has the potential to increase business significantly while reducing the threat of additional immediate competition. The C-LEC, in turn, sees an established service with a known technology and proven performance—and less incentive to purchase their own system, at least in the near term.

The telephony business is significantly different from what SMR providers may have dealt with in the past. It has its own set of business expectations, paradigms for customer service and maintenance philosophy. This doesn't make it impossible to deal with these companies, you just have to do your homework. In fact, many of the new C-LECs are successful because their "corporate culture" significantly differs from the old Bell system. ■

References

Calhoun, George C., *Wireless Access and the Local Telephone Network*, Artech House, Boston, 1992.

Freeman, Roger L., *Telecommunication System Engineering*, 3rd ed., Wiley, New York, 1996.

Reeve, Whitham D., *Subscriber Loop Signaling and Transmission Handbook: Analog*, IEEE Press, Piscataway, NJ, 1992.

Reeve, Whitham D., *Subscriber Loop Signaling and Transmission Handbook: Digital*, IEEE Press, Piscataway, NJ, 1995.

Web references

On the World Wide Web, use the keywords "local loop," "CLEC," "wireless." Applicable sites include www.clecinfo.com, www.bellcore.com and www.fcc.gov.

An exceptional site is www.nortel.com. It has excellent tutorials, particularly "Telephony 101," "Long Distance 101" and "SONET 101."

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Improving PCS reliability through cell frequency management

Adding additional neighbors to each sector builds in a strategy for improving system reliability with no additional cost in hardware.

By E. Kirk Ellis

In the last few years, there has been an explosion of cell site growth in the wireless industry. Many PCS carrier's system designs do not have the redundancy of their earlier cellular counterparts necessary to meet an aggressive buildout schedule. Some of this is due to the nature of the equipment design or the inherent weaknesses of the format. For example, GSM and TDMA typically use one RF carrier and multiplex several timeslots (talk slots, or logical channels) on one RF transmitter

per sector. Failure of this single transmitter takes the sector out, opening up a coverage "hole."

Many sites have been deployed without ac generators for backup or with backup battery capacity of only an hour. To meet the aggressive buildout, providers have deployed most PCS sites using the local telco's T1 wire facilities instead of microwave. Wired T1s are much less reliable than microwave and inherently fail much more often. All of these factors can take a PCS site completely out in short order, often for hours (or even days) before it can be restored.

With its reduced coverage, as compared to 800MHz cellular, there are many more cell sites required for PCS. This inherently offers some opportunity for redundant coverage, but only if the RF frequency "neighbor list" is correctly implemented. This article discusses some ways to implement this backup coverage. GSM systems are the primary focus, but the underlying theory should apply to other technologies as well, including TDMA and some cellular systems.

Neighbor lists and implementations

A neighbor list is a group of parameters that are stored in the cellsite data base con-

tained in the base station controller (BSC), which is typically located in the mobile switching center (MSC). The neighbor list consists of the channels (frequencies) assigned to the site (including its adjacent sectors) and the channels assigned to the neighboring cell sites.

These neighbor lists are downloaded into the BSC and are used by the BSC to control mobile handoffs between adjacent sectors and neighboring cell sites.

An example will help to clarify this

Ellis is a senior network engineer for BellSouth Mobility, DCS, Raleigh, NC.

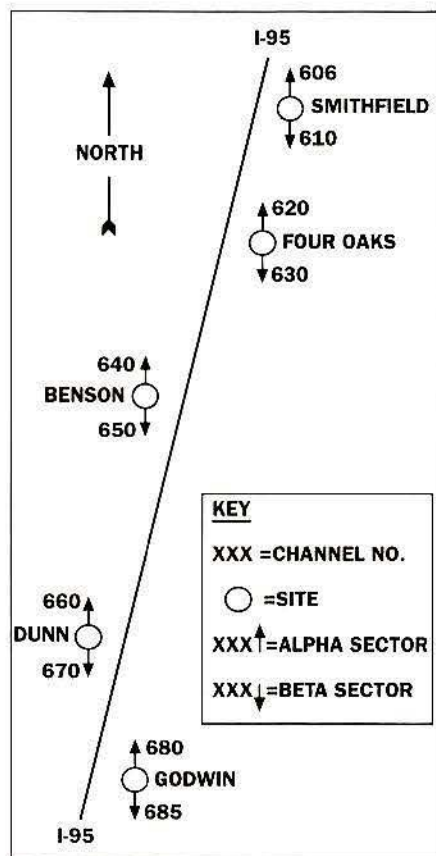


Figure 1. Site location and frequency assignments are shown for a section of I-95 in North Carolina.

Table 1. Site frequency assignment.

SITE	SECTOR	FREQUENCY
Smithfield	alpha	606
Smithfield	beta	610
Four Oaks	alpha	620
Four Oaks	beta	630
Benson	alpha	640
Benson	beta	650
Dunn	alpha	660
Dunn	beta	670
Godwin	alpha	680
Godwin	beta	685

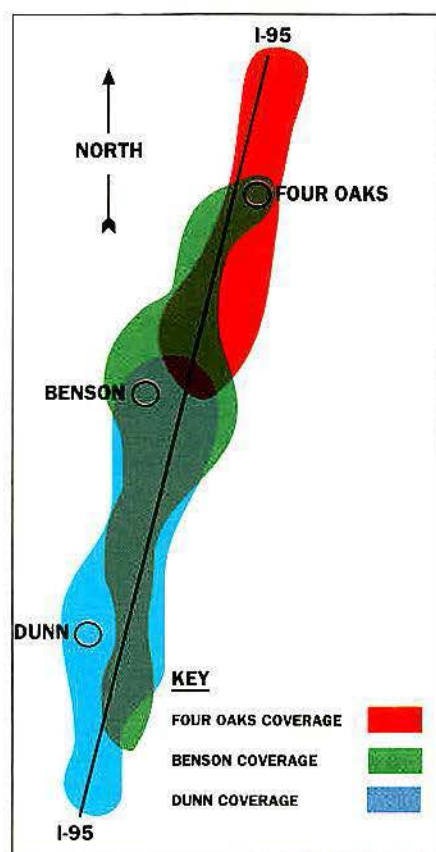


Figure 2. Coverage overlaps when all sites and sectors are on the air.

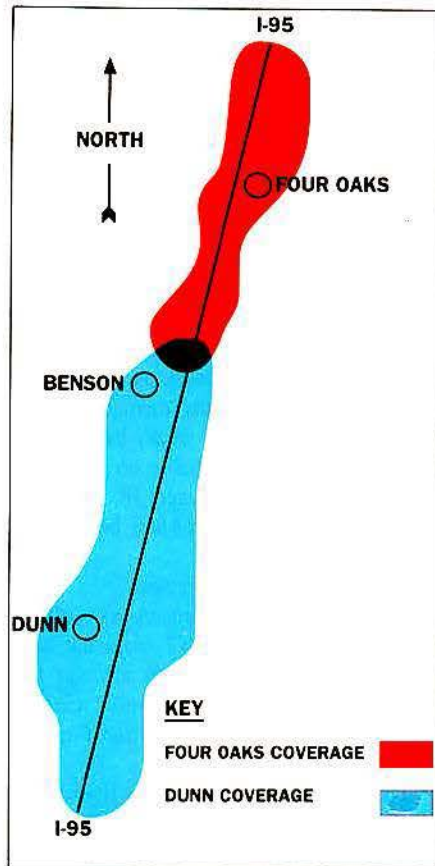


Figure 3. When the T1 is cut, Benson goes off the air, and the coverage changes.

datafill. Imagine a simple system based on highway coverage, using three two-sector sites. This is a typical configuration where coverage is of prime importance, and capacity is not the driving factor.

The hypothetical cell sites are part of the RF buildout designed to cover Interstate 95. Cell sites are located at the towns of Four Oaks, Benson and Dunn as shown in Figure 1 on page 38.

The distance between these sites is covered by deployment of directional antennas pointing up and down the interstate. On a typical PCS1900 GSM system, a channel consists of a control time slot and seven talk time slots. Convention has it that the alpha sector points north and the beta sector points south.

At Four Oaks, the north sector (alpha) is assigned channel 620. The south sector (beta) is assigned channel 630 (see Figure 1 and Table 1 on page 38).

To the south of Four Oaks lies the town of Benson. Its cell site has channel 640 loaded in the alpha sector and channel 650 loaded in the beta sector. Continuing south on I-95, we reach the town of Dunn, with its cell site loaded with channel 660 (alpha sector) and channel 670 (beta sector).

This buildout continues up and down I-95 with cell sites located about every five miles

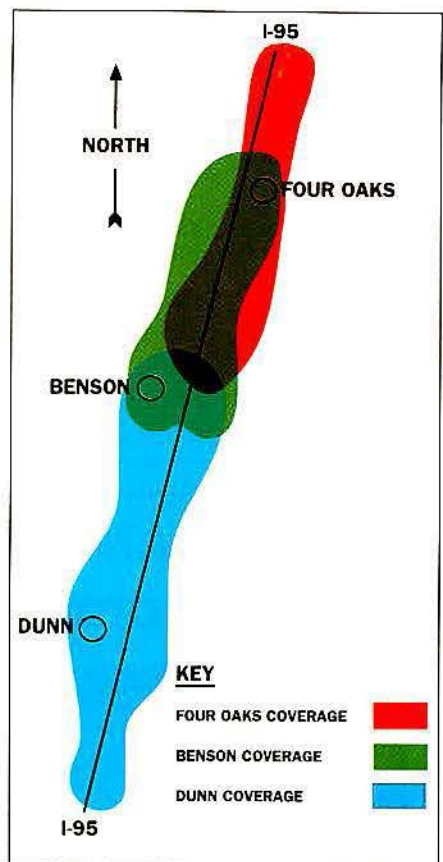


Figure 4. Coverage changes again when the Benson beta transmitter fails.

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Table 2. Original basic neighbor list (typical).

SITE	SECTOR	NEIGHBORS
Four Oaks	alpha	610, 630
Four Oaks	beta	620, 640
Benson	alpha	630, 650
Benson	beta	640, 660
Dunn	alpha	650, 670
Dunn	beta	660, 680

(Note: For illustration purposes, only the three sites used in the examples are shown)

north and south of this part of the system.

Cell site mobile handovers

Before we can look at a failure mode, it is necessary to look at the basic operation of the system and its intracell and intercell handovers. Suppose a car is traveling south on I-95 and approaches the town of Four Oaks. At some point north of town, the mobile originates a call. The call is established on channel 620 (alpha). As the mobile passes by the site, the intracell handover occurs according to the data in the site's neighbor list. Typical implementation has channel 630 loaded, so the mo-

bile is handed off from alpha (channel 620) to beta (channel 630). The beta sector has its neighbor list loaded with channel 620 (intracell neighbor) and channel 640 (intercell neighbor), which is the alpha sector of the site at Benson. These handovers continue in the same fashion, and as the car travels south on I-95, the mobile is handed off from channel 640 to 650, from 650 to 660, 660 to 670 and so on.

One last point. Coverage from Four Oaks overlaps the Benson site, and coverage from Dunn also overlaps the Benson site. The coverage at the town of Benson from these two sites is weak, but useable, even without the Benson site on the air, as shown in Figure 2 on page 38.

Here is where the problem begins.

Failure modes and coverage

Suppose the site at Benson goes off the air due to a cut leased T1 from the local Telco, which occurred when a water line was installed between the local Central Office and the Benson site. (See Figure 3 on page 39).

The cut T1 renders the site at Benson unavailable, as call traffic cannot reach the MSC for processing. The site shuts down automatically when it loses communications with the MSC.

Our hypothetical user passes by the Four Oaks site, which is loaded with the now-absent Benson alpha sector. Although adequate coverage to maintain a call exists between Four Oaks and Dunn, without Benson on the air, the sites do not know about each other because they are not on each other's neighbor lists. Hence, as the mobile caller travels down I-95, Four Oaks cannot hand off to Dunn. Somewhere between the two, where Four Oaks' coverage ends, the call is dropped.

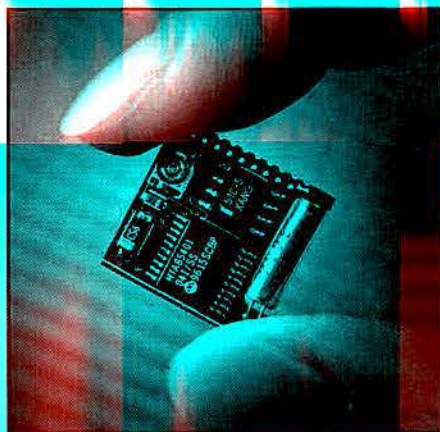
The neighbor lists, as initially implemented by the original RF engineering for these sites, are listed in Table 2 above. These are typical basic neighbor implementations found in many carriers' systems.

In the second example (see Figure 4 on page 39), the beta transmitter at the Benson site fails. This is a typical GSM failure that takes a sector down. If a call is up, it passes from the Four Oaks beta sector to the Benson alpha sector as normal.

However, as the mobile caller passes Benson, a problem begins. Because the beta sector is off the air, the alpha sector of Benson has nowhere to hand off to, even though coverage is available from the Dunn alpha sector. The site simply does not know that the other sector (Dunn channel 660) is available because it is not loaded into its neighbor list.

Table 2 shows that the only neighbors

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Table 3. Improved neighbor list (with redundant coverage).

SITE	SECTOR	NEIGHBORS
Four Oaks	alpha	606, 610, 630, 640, + beta sector of site north of the Smithfield site
Four Oaks	beta	610, 620, 640, 650, 660
Benson	alpha	610, 620, 630, 650, 660
Benson	beta	630, 640, 660, 670, 680
Dunn	alpha	630, 640, 650, 670, 680
Dunn	beta	650, 660, 680, 685, + alpha sector of site south of Godwin site

(Note: For illustration purposes, only the three sites used in the examples are shown.)

loaded into the Benson alpha sector are Four Oaks channel 630 to the north and its adjacent sector to the south on the same tower, channel 650, which currently is off the air.

The mobile "drags" the coverage from Benson alpha around the site to the south side and the call drops shortly after the mobile passes by.

Neighbor list additions

What would have happened in the previous two examples if the neighbor lists in Table 3, above, had been implemented instead of the neighbor lists in Table 2. The new neighbor list has three more entries per sector for neighbors (five instead of two).

The list has more neighbors because it is looking ahead one sector in each direction past its immediate neighbor. Compare the Table 2 typical implementation with the Table 3 implementation, looking at the Benson alpha sector as an example.

In the basic implementation in Table 2, Benson alpha only has its immediate neighbors loaded, that is, Four Oaks beta sector at the site to the north, channel 630, and Benson beta channel 650 to the south, located at the same site.

In the improved implementation, the site knows to look ahead. The system parameters are set to use the strongest available neighbor, so under normal system operation, the neighbor lists cause handovers to proceed exactly as in Table 2.

To the north, Benson alpha not only looks at Four Oaks beta, but knows that Four Oaks alpha and Smithfield beta exist as well. Likewise, to the south, in addition to its own beta sector, it also knows that Dunn alpha and beta and Godwin alpha exist.

What will happen this time when the TI is cut to the site at Benson? The site at Benson is off the air. A southbound caller initiates a call and is on the alpha sector of Four Oaks. As he passes the site, he is handed off from Four Oaks alpha to beta (intracell handover). The mobile continues south on I-95. The site at Benson is not on the air, but this time the neighbor list makes the call available for handover

to the alpha sector at Dunn. Although call quality is not as good as normal, the call does stay up and is not dropped as the mobile moves from Four Oaks beta to Dunn alpha. The hole in coverage with the failure of the Benson site has been reduced to a weak area, all done by neighbor list data fill.

In the second scenario, repeated from above, the Benson beta transmitter has failed. As the vehicle travels south from Four Oaks toward Benson, all is well. When the caller goes past the Benson site, instead of "dragging" the alpha sector around the south side of the site, the neighbor list indicates that Dunn alpha exists, and the call is handed off to Dunn alpha

instead of being dropped. Again, proper neighbor list loading has prevented dropped calls by filling in a coverage hole caused by equipment failure.

Summary

Clearly, in many locations, system redundancy can be built in by using existing coverage that is not normally used when all sites are on the air. When all sites are operating normally, handovers occur in the simplistic fashion shown in Table 2. However, adding additional neighbors to each sector builds in a strategy for improving system reliability with no additional cost in hardware.

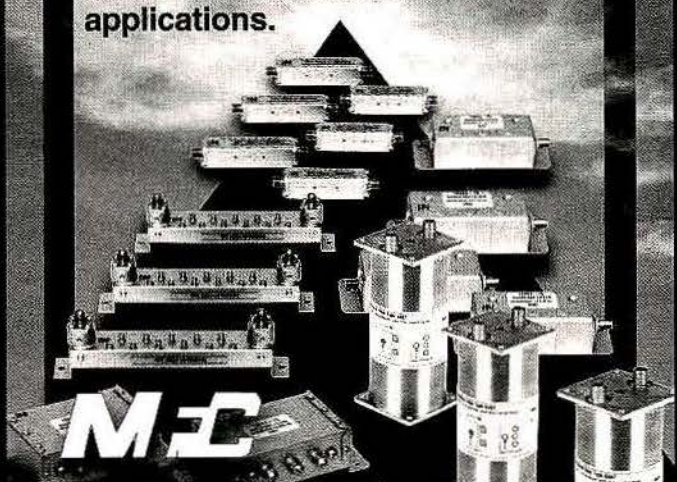
In these cases, call quality will most likely be degraded, but call processing will continue, with handovers being made, and will not necessarily drop if the sites are appropriately spaced.

Not implementing additional neighbors will definitely cause dropped calls as the mobile drives into a failure-induced hole and the sector is "dragged" out.

This strategy is easily implemented with a little additional time and planning when the RF engineering of the system is done. Having fewer dropped calls and apparent holes keeps customers happier, reducing churn and increasing revenues. ■

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Due process goes south in deal with north

The secret deal for Canadian SMR Channels



Illustration by Scott Dolash

By Robert H. Schwaninger Jr.

On May 14, 1998, the FCC secretly entered into an agreement with our neighbors in Canada to allow Nextel and its Canadian counterpart, Clearnet, to use 800MHz channels along the U.S.-Canadian border, for which use is precluded for all other licensees by rule.

In essence, the agreement would allow one U.S. company, McLean, VA-based Nextel Communications, and one Canadian company, Clearnet, to do what no other American company has been allowed to do for over a decade—that is, to use 800MHz channels in one country that have been exclusively allocated for use in the other country.

The document, "Special Coordination Procedures for the Use of Frequencies in the Bands 806-821MHz and 851-866MHz for

Land Mobile Services," was signed by Ronald Amero, director, Space and International Regulatory Activities, Industry Canada, on April 9, 1998, and was cosigned on May 14, 1998, by a representative for Regina Keeney, chief of the FCC's International Bureau (IB).

Table 2. Geographic area: within 100km of the United States-Canada border between 74° 30' and 76° W longitude.

Paired frequencies with U.S. priority use (MHz)	Paired frequencies with Canadian priority use (MHz)
818.9625	863.9625
818.9875	863.9875
819.0125	864.0125
819.1125	864.1125
819.1375	864.1375
819.4125	864.4125
819.4375	864.4375
819.4625	864.4625
819.5625	864.5625
819.5875	864.5875
819.8625	864.8625
819.8875	864.8875
819.9125	864.9125
820.0125	865.0125
820.0375	865.0375
820.3125	865.3125
820.3375	865.3375
820.3625	865.3625
820.4625	865.4625
820.4875	865.4875
820.7625	865.7625
820.7875	865.7875
820.8125	865.8125
820.9125	865.9125
820.9375	865.9375
809.2125	854.2125
809.4625	854.4625
809.9125	854.9125
810.1625	855.1625
810.4125	855.4125
810.8875	855.8875
811.1375	856.1375
813.2375	858.2375
813.4875	858.4875
813.7375	858.7375
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814.9875	859.9875
816.2875	861.2875
816.5375	861.5375
816.7875	861.7875
817.0375	862.0375
817.2875	862.2875
817.5125	862.5125
817.7625	862.7625
818.0125	863.0125
818.2625	863.2625
818.5125	863.5125

Note: Frequencies listed above will be used for the IDEN digital network only. (Source: FCC documents.)

Table 1. Geographic area within 100km of the United States-Canada border between 72° and 74° 30' W longitude.

Paired frequencies with U.S. priority use (MHz)	Paired frequencies with Canadian priority use (MHz)
819.3875	864.3875
819.6875	864.6875
819.7125	864.7125
819.8375	864.8375
820.6875	865.6875
820.7375	865.7375
814.7125	859.7125
816.3125	861.3125
816.8125	861.8125
817.3125	862.3125
818.4375	863.4375
818.5375	863.5375

Note: Frequencies listed above will be used for the IDEN digital network only. (Source: FCC documents.)

Judging by footnotes and references, the document had been in the works since at least Jan. 9, 1997.

The text of the agreement is fairly short, running only two pages (see page 43), with a seven-page annex of channel charts that identify the hundreds of frequencies Nextel can use in the United States and that Clearnet can use in Canada. The agreement and the associated channel charts (reproduced as Tables 1 through 5 throughout this article) are amazing in their effect and what they say about the state of affairs in our government.

The agreement allows one, and only one, company to avoid the channel allocation scheme that has existed between the United States and Canada since 1982 and that has limited the number of available channels above "Line A" for all applicants and licensees. Line A is an imaginary line at a fixed distance from, and approximately parallel to, the Canadian border.

Although the agreement language mentions Nextel and Clearnet, the agreement attempts to appear neutral as to other operators that might also be able to use the frequency-sharing arrangement across the border. For example, if a company in Syracuse, NY, can find a sister company in

Schwaninger, MRT's regulatory consultant, is a partner in the law firm of Brown and Schwaninger, Washington, DC. He is a member of the Radio Club of America.

Special Coordination Procedures for the Use of Frequencies in the Bands 806-821MHz and 851-866MHz for Land Mobile Services

Recognizing that the priority use of frequencies by the United States of America and Canada remains pursuant to Section 3 of the *Arrangement Concerning the Use of the Band 806-890MHz Along the Canada-United States Border*¹, as amended², between the Federal Communications Commission (FCC) and Industry Canada³ hereafter referred to as the Agencies;

Recognizing further that administrations must maintain the flexibility to assign frequencies from their respective frequency blocks where they enjoy priority usage, using their chosen method of authorization;

Recognizing that there may be licensees/operators other than Nextel Communications Inc. in the U.S. or Clearnet Inc. in Canada on frequencies identified in Annex A;

Recognizing that the use of frequencies identified in Annex A may be different beyond 100km of the border than that within this border zone;

Noting that business arrangements may exist between Canadian and U.S. system operators, in this case Clearnet Inc. and Nextel Communications Inc., which provide for spectrum-efficient, seamless frequency re-use plans that extend across the Canada/U.S.A. border and facilitate roaming;

It is AGREED that:

Industry Canada and the FCC may authorize these system operators to use specific frequencies, as set forth in Annex A (consisting of five parts) and incorporated herein by reference, within 100km of the United States-Canada border that exceed the Power Flux Density limits specified in the Arrangement and are in the other countries' frequency block provided that the following conditions are placed on such authorizations:

- the system operators must file with their representative Agency a copy of the business arrangement listing the frequencies they would be sharing and in which geographical areas;
- agreement will be reached between the Canadian and U.S. licensees for each proposed station within the relevant geographical service area before it is placed in operation;
- in the event that the operations provided for herein cause harmful

interference to primary operations in either country, the system operators will take immediate action to mitigate the situation. Should resolution of the interference situation not be found, the interfering station will be required to cease operation within 10 calendar days except, in the case where public safety licenses are affected, operations would cease immediately upon being advised;

- no service may be offered by the Canadian licensee within the U.S. and, no service may be offered by the U.S. licensee within Canada; and,
- any changes to the notified business arrangement will require a review by the Agencies.

The authorizing Agency shall send a notification to the other Agency for each frequency assigned under the terms of this procedure.

In the event that any of the authorized frequencies listed in Annex A are affected by subsequent licensing action by either Agency, operations on these affected frequencies in the other country will cease within three months from date of notification.

For any reason whatsoever, this procedure may be subject to unconditional withdrawal by either Agency giving three months written notice.

This procedure is accepted as a revised understanding between the FCC and Industry Canada and replaces Special Coordination Procedure previously issued to Nextel Communications Inc. and Clearnet Inc., originally signed January 9, 1997. This revised procedure will come into effect on the date of signature by representatives of both Agencies.

(signed)
Regina M. Keeney
Chief, International Bureau
Federal Communications Commission
May 14, 1998

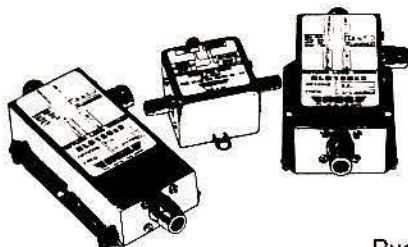
(signed)
Ronald Amaro
Director, Space and International
Regulatory Activities
Industry Canada
April 9, 1998

¹Arrangement between the Department of Communications of Canada and the Federal Communications Commission of the United States concerning the use of the band 806-890MHz along the Canada-United States border, dated April 7, 1982.

²See exchange of letters between the FCC and Industry Canada dated December 10, 1994.

³Formerly the Department of Communications.

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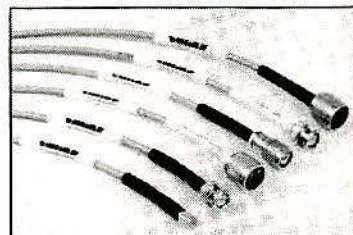
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Canada that will agree to share channels across the border, then, theoretically, the company in Syracuse could use some Canadian channels and vice versa. At last check, only one U.S. company, Nextel, had an affiliated Canadian company with which to use the terms of the agreement. Given the recent 800MHz auction, this number is unlikely to increase.

Motorola's involvement

If you scan the pages of the agreement and charts, you will not find the name "Motorola." The language of the agreement does not say,

for example, "At the behest of the biggest, blue-bat behemoth in land mobile equipment sales on either side of Lake Erie, we, the brow-beaten members of the FCC and Industry Canada, hereby declare. ..." The document is a bit more subtle than that.

However, the fact that Motorola stands to benefit by the deal is carved into the footnotes of the frequency charts that read: "Note: Frequencies listed above will be used for the IDEN digital network only." Stated another way, if you want to benefit by this agreement, buy Motorola, and buy often.

Table 3. Geographic area: within 100km of the United States-Canada border between 76° and 81° W longitude.

Paired frequencies with U.S. priority use (MHz)		Paired frequencies with Canadian priority use (MHz)	
818.7625	863.7625	809.1625	854.1625
818.8375	863.8375	809.2125	854.2125
818.9625	863.9625	809.2375	854.2375
819.0125	864.0125	811.1125	856.1125
819.0375	864.0375	811.1625	856.1625
819.0625	864.0625	811.6125	856.6125
819.0875	864.0875	811.6625	856.6625
819.1125	864.1125	813.1625	858.1625
819.1375	864.1375	813.6625	858.6625
819.1625	864.1625	814.1625	859.1625
819.2125	864.2125	815.0625	860.0625
819.2375	864.2375	815.1375	860.1375
819.2875	864.2875	815.6375	860.6375
819.4125	864.4125	816.0875	861.0875
819.4625	864.4625	816.1375	861.1375
819.4875	864.4875	816.2875	861.2875
819.5125	864.5125	816.3375	861.3375
819.5375	864.5375	816.3875	861.3875
819.5625	864.5625	816.5375	861.5375
819.5875	864.5875	816.5875	861.5875
819.6875	864.6875	816.6375	861.6375
819.7125	864.7125	816.7875	861.7875
819.7875	864.7875	816.8375	861.8375
819.8625	864.8625	816.8875	861.8875
819.9125	864.9125	817.1375	862.1375
819.9375	864.9375	817.3375	862.3375
819.9625	864.9625	817.3875	862.3875
819.9875	864.9875	817.5125	862.5125
820.0125	865.0125	817.5625	862.5625
820.0375	865.0375	817.5875	862.5875
820.0625	865.0625	817.6125	862.6125
820.1125	865.1125	817.6375	862.6375
820.2375	865.2375	817.7625	862.7625
820.2625	865.2625	817.8125	862.8125
820.3625	865.3625	817.8875	862.8875
820.3875	865.3875	818.0125	863.0125
820.4125	865.4125	818.0625	863.0625
820.4375	865.4375	818.0875	863.0875
820.4625	865.4625	818.1125	863.1125
820.4875	865.4875	818.1375	863.1375
820.5125	865.5125	818.2625	863.2625
820.5875	865.5875	818.3125	863.3125
820.7125	865.7125	818.3375	863.3375
820.8125	865.8125	818.3625	863.3625
820.8375	865.8375	818.3875	863.3875
820.8625	865.8625	818.5125	863.5125
820.8875	865.8875	818.5625	863.5625
820.9125	865.9125	818.5875	863.5875
820.9375	865.9375	818.6125	863.6125
820.9625	865.9625	818.6375	863.6375

Note: Frequencies listed above will be used for the IDEN digital network only. (Source: FCC documents.)

There's a real problem here. Since when does the U.S. government enter into deals with foreign countries that identifies a proprietary technology in the terms of the negotiated agreement? ("Earth" to International Bureau Chief Regina Keeney. There's a call for you from the U.S. Department of Justice Antitrust Division on line two.")

Then there's that other little element lurking in the background. As I recall, Motorola owns about 30% of the equity in Nextel (and hence Clearnet). So what we have here is the "Canadian/U.S. IDEN Relief Act of 1998," complete with enough caveats to preclude any other entity from enjoying the fruits of this clandestine compact.


To say that this deal "isn't fair" is to do a disservice to the word *fair*. This little cabal of U.S./Canadian chicanery is so patently

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unfair that it makes a mockery out of due process and points out how far wrong the FCC can go if it fails to allow the American public to look over its shoulder.

Okay, so I'll be fair. In a meeting I had with staff members of the IB in August, it appeared that the staff never thought that the deal would be a problem.

"Nobody ever complained about other agreements we've brokered," they said.

The IB appeared to be acting under the advice of the Wireless Telecommunications Bureau, which also evidently does not have a copy of the FCC rules. Could it be the IB was lured into the swamp by the WTB?

Why the cloak and dagger?

The FCC's action, without public notice, comment, rulemaking or any mention in any official document publication, is quite curious. Why the secrecy? There are many local operators of SMR systems in Region 2 (upstate New York) and along the Canadian border all the way to Puget Sound in Washington. So why weren't these SMR operators informed about the discussions with Industry Canada (formerly the Canadian Department of Communications)?

Obviously, numerous other companies would be vitally interested in participating in any discussion that might allow any of them

to achieve additional channels. Those same operators might be quite concerned to learn that Nextel is poised to increase their competitive position via additional channel depth through a sweetheart international agreement. So why the secrecy?

Maybe the whole affair was well-covered in the "Toronto City Gazette" next to the Blue Jays' box scores. But the Associated Press missed the story, and the FCC never put it on the wire. Frankly, the only way I found out about it was that one of my clients tripped across the agreement almost by accident. It was *not* posted on the FCC's Web site.

The agreement was inked about two months ago, but I missed the "grip-and-grin" photos of diplomats as they shook hands in cyberspace on the deal, using the FCC's new Universal Licensing System, thereby adding \$2.30 per minute to the cost of negotiations.

At the same time that the FCC is claiming increased access to its procedures via the Internet, the agency has failed to consider what happens if its actions are kept off the Web, out of public notices, outside the pages of the *Federal Register* and holed up in file cabinets of the International Bureau.

The only plausible reason for the agency's failure to make public this discussion with

Table 4. Geographic area: within 100km of the United States-Canada border between 81° and 85° W longitude.

Paired frequencies with U.S. priority use (MHz)	Paired frequencies with Canadian priority use (MHz)
809.6625	854.6625
809.9125	854.9125
817.7375	862.7375
818.9875	863.9875
819.4125	864.4125
819.4375	864.4375
819.4625	864.4625
819.4875	864.4875
819.5125	864.5125
819.5375	864.5375
819.6375	864.6375
819.6875	864.6875
819.7375	864.7375
819.7625	865.7625
819.7875	864.7875
819.8375	864.8375
819.8625	864.8625
819.9125	864.9125
819.9875	864.9875
820.4375	865.4375
820.4625	865.4625
820.5375	865.5375
820.6375	865.6375
820.6875	865.6875
820.7375	865.7375
820.7625	865.7625
820.8375	865.8375
820.8625	865.8625
811.2625	856.2625
811.4375	856.4375
811.5125	856.5125
811.6875	856.6875
811.7625	856.7625
811.9375	856.9375
812.0125	857.0125
812.1325	857.1325
812.1875	857.1875
812.2625	857.2625
812.3875	857.3875
812.4375	857.4375
813.1875	858.1875
813.2375	858.2375
813.4375	858.4375
813.4875	858.4875
813.6875	858.6875
813.7375	858.7375
813.9375	858.9375
813.9875	858.9875
814.1875	859.1875
814.2375	859.2375
814.4875	859.4875
814.7375	859.7375
814.9875	859.9875
815.0625	860.0625
815.3125	860.3125
815.5625	860.5625

Note: Frequencies listed above will be used for the IDEN digital network only. (Source: FCC documents.)

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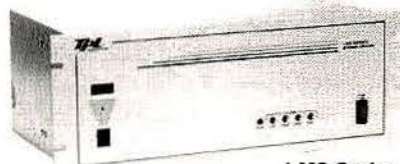
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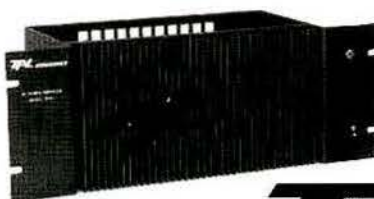
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Canada is that it *stinks* and the FCC *knows* that it stinks. It stinks the same way that John D. Rockefeller's secret deals with the railroad smelled, only this time the robber barons are trading in spectrum, rather than oil, and they're using the federal government as their broker.

Yeah, but is it legal?

This agreement is fine, as long as Nextel doesn't actually start *using* Canadian channels north of Line A. *Huh? What the heck are you talking about, Schwaninger?* Okay, here's the deal. The governments of Canada and the United States can get to-

gether and agree on anything they want. They can decide that in case of Martian attack, only women named Greta will be allowed to breed with planetary-challenged people. These handshake (or tentacle-shake) deals can be struck, and it means little—*unless* it gets approved by the U.S. Senate via a treaty procedure.

To be legally effective, however, these semi-formal agreements must comport with the laws of the local countries. In the case of this particular agreement, that may be a big problem. First, the agreement would create a change in the FCC rules. Such changes may only be made pursuant to no-

Table 5. Geographic area: within 100km of the United States-Canada border between 121° 30' and 125° W longitude.

Paired frequencies with U.S. priority use (MHz)		Paired frequencies with Canadian priority use (MHz)	
817.5125	862.5125	810.1375	855.1375
817.5375	862.5375	810.1875	855.1875
817.5875	862.5875	810.3875	855.3875
817.6625	862.6625	810.4375	855.4375
817.6875	862.6875	810.6375	855.6375
817.7125	862.7125	810.6875	855.6875
817.8125	862.8125	810.9375	855.9375
818.0125	863.0125	811.0875	856.0875
818.0625	863.0625	811.1125	856.1125
818.1125	863.1125	811.1375	856.1375
818.3375	863.3375	811.5875	856.5875
818.4375	863.4375	811.6375	856.6375
818.5375	863.5375	812.0875	857.0875
818.5875	863.5875	812.1125	857.1125
818.7125	863.7125	813.0375	858.0375
818.7375	863.7375	813.0875	858.0875
818.8375	863.8375	813.1125	858.1125
819.0375	864.0375	813.1375	858.1375
819.0625	864.0625	813.1875	858.1875
819.1125	864.1125	813.8375	858.8375
819.2125	864.2125	813.8875	858.8875
819.2875	864.2875	814.0375	859.0375
819.3125	864.3125	814.0875	859.0875
819.4125	864.4125	814.1125	859.1125
819.4375	864.4375	814.1375	859.1375
819.4625	864.4625	814.1875	859.1875
819.4875	864.4875	815.0375	860.0375
819.5125	864.5125	815.0625	860.0625
819.5625	864.5625	815.0875	860.0875
819.5875	864.5875	815.1125	860.1125
819.6875	864.6875	815.1375	860.1375
819.7875	864.7875	815.2875	860.2875
819.8375	864.8375	815.3125	860.3125
819.8625	864.8625	815.3875	860.3875
819.9125	864.9125	815.5375	860.5375
819.9375	864.9375	815.5625	860.5625
819.9625	864.9625	815.5875	860.5875
819.9875	864.9875	815.6375	860.6375
820.1125	865.1125	815.7875	860.7875
820.3125	865.3125	815.8125	860.8125
820.3375	865.3375	815.8375	860.8375
820.3875	865.3875	815.8875	860.8875
820.4375	865.4375	816.0375	861.0375
820.5875	865.5875	816.0625	861.0625
820.6375	865.6375	816.0875	861.0875
820.6875	865.6875	816.1125	861.1125
820.7375	865.7375	816.1375	861.1375
820.7625	865.7625	816.2125	861.2125
820.8375	865.8375	816.2375	861.2375
820.8625	865.8625	816.3875	861.3875

Note: Frequencies listed above will be used for the IDEN digital network only. (Source: FCC documents.)

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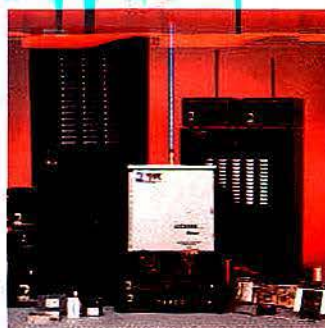
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tice-and-comment rulemaking in accord with the Administrative Procedures Act. No rulemaking—no deal.

Next, the deal would have to be shown to be in the public interest and not harmful to small business in accord with the Regulatory Flexibility Act. I humbly suggest that a deal that benefits only one entity and its major equipment supplier is unlikely to be found to be "in the public interest," and I further suggest that the effect of allowing Nextel carte blanche in avoiding the prohibitions on the use of Canadian frequencies *will be* deemed detrimental to competing, small businesses.

Next, the deal would have to conform with the terms of the most recent 800MHz auction of the upper 200 channels and the decisions within the orders for future action

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on the lower 150 channels. If the agency knew this deal was in the works (which the agreement implies) and failed to inform the public, then the auction was an even bigger farce than suspected.

The courts take a dim view of agency actions that provide a special benefit to a single entity while hiding its gift within unpublished deals squirreled away in the files. What possible comments might have been received to the auction dockets if all commenters had been informed about these pending negotiations? Who else might have joined the bidding? We don't know—and neither do the courts.

Then there's the freeze. Many of the channels that Nextel might want to license in accord with the deal are caught up in an application freeze. How does Nextel get around the freeze? Again, those pesky

U.S. laws are in the way.

There's also the problems of *ex parte* actions before and by an agency that fails to notify affected parties; figuring out frequency coordination issues; failure to provide publication of a substantive rule change, thereby causing the document to be legally ineffective; and a host of other little problems generally known as laws, statutes, due process and equity.

So, as bird cage liner, the agreement is interesting. As a legally enforceable document allowing Nextel to avoid the plain language of the FCC rules, it has a way to go.

Kill it before it mutates

If history is our best teacher, then the industry should recognize that Nextel will use this two-page agreement as justification for moving forward in its plan to leverage its Canadian channels. We should not let this occur. Fortunately, the agreement itself provides an out.

One of the terms of the agreement states, "[f]or any reason whatsoever, this procedure may be subject to unconditional withdrawal by either Agency giving three months written notice." I suggest that we, the American people, remind our government that such sweetheart deals are not to be tolerated in a free-enterprise system.

I respectfully recommend that every SMR operator, every private user of 800MHz channels north of Line A, every community

repeater operator who ever had to get Canadian clearance, CTIA, AMTA, PCIA, SBT, ITA, UTC, and every other association whose members were left off the invitation list to discuss the agreement, contact the FCC and tell them to withdraw immediately. These demands should include a request that any further discussion regarding future use of 800MHz channels north of Line A should include representatives of *all* affected parties.

Government works best when it works in the open, not behind closed doors. The Sunshine Act and the Freedom of Information Act and similar legislation were created specifically to allow citizens to review and participate in the decision-making process of our elected and appointed representatives. Secret deals that provide gross favoritism to a single company must be vigorously discouraged.

The history of the FCC's regulation of Nextel is one of constantly emerging evidence of secret deals. The original Fleet Call waiver request in 1991, which was signed by a host of ex-FCC officials; the expansion of loading credit, which allowed Nextel to claim sufficient loading for any requested facility; the grant of the OneComm applications in 1994, en masse and on a Saturday, which was explained by reference to an electronic filing method that was unpublished, untried, and unknown before or since that date; the acceptance of thousands of Nextel applications without coordination, or proper fees, or engineering for which the FCC has formally published a denial, but which its records show is completely true; the forbearance by the agency to demand construction information from Nextel despite its receipt of a request to do so in 1996; the grant to Nextel of hundreds of improperly short-spaced channels in the FCC's computer run of 1995; the FCC's allowing Motorola to sell a 900MHz wide-area license that was improperly granted by the FCC in violation of a U.S. Justice Department consent decree involving Nextel; the grant of assignment applications to Nextel for its purchase of hundreds of unconstructed Transit Communications channels; the FCC's progressing with the 800MHz auction without required authorization by the Small Business Administration in 1997; and on and on. The list of known shenanigans is practically endless.

It is time that the industry demand that Nextel receive equal treatment under law. It is time for Congress to seek resignations from all federal employees who have participated in brokering these deals.

It is time for the agency to admit its problems, its weaknesses and its inability to resist participation in improperly providing assistance for unfettered growth of a single, favored company.

It is time for something as basic and hokey and necessary as honest government. ■



D.T.M.F DECODER

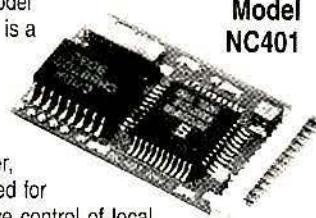
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Model
NC401



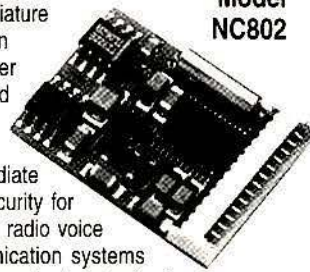
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The Model NC802 is a miniature inversion scrambler designed to

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Circle (64) on Fast Fact Card

The backup plan (Plan B?)

By Harold Kinley, C.E.T.

Even the best-laid plans can run amuck. No matter how many backup systems you have in place, you will never achieve 100% reliability. You *might* achieve 99.9999% or better, but never 100%. I am speaking of communication systems in general and dispatching systems in particular.

Why is it that the 0.0001% of downtime is what sticks in the mind of those who sign our checks? Never mind the 99.9999% of the time that the system was "up" and operating normally. Another thing—why is it that the "down" time always seems to occur at a *critical* time? Is it a perceived problem or a real problem? If the boss perceives it as a problem, it is a real problem to us! And believe me—when the dispatch center goes down, the boss will perceive it as a problem!

As our world of electronics has become more sophisticated (read, "computer-dependent"), our capabilities have greatly expanded. The capabilities of such sophisticated equipment are limited primarily by the imaginations of those designing or buying such equipment. All of the proverbial "bells and whistles" that can be attached to the ultra-sophisticated, computerized equipment are nice to have but may not be so essential when the chips are down. This sophistication comes with a price beyond the purchase and initial installation costs. Maintenance requirements are more stringent and require greater technical expertise than they did for older technology. The problem becomes more com-

plex when we "put all our eggs into one basket."

A perfect example is the dispatching center of my own employer, the South Carolina Forestry Commission. Just a few years ago we had a large network of lookout towers, as did most of the forestry services in this country. Our radio system was simple—literally, *simplex*! We had no repeaters (unless you can call one tower attendant relaying to another a "repeater"—a human repeater, if you will). Each county had several lookout towers, with one tower designated as the dispatch tower for each county. Thus, we had single-county dispatching.

The time came when the old lookout towers were phased out and replaced with air patrol—the passing of an era. There is something about a lookout tower that can't be replaced by airplanes—although our pilots do a good job of detecting and directing the suppression of wildfires.

Then came more reorganization. Districts were combined to form regions, and several forestry "areas" were carved out of the regions. A region typically has five forestry areas, typically consisting of about four counties each. Every area was set up (crudely) to dispatch for the counties within it. Thus, we had four-county dispatching in typical areas.

Ultimately, dispatching was moved to a central point within the region. The dispatching center now serves the entire region (19 counties). The region is so large that the weather might be wet in one part of the region while wildfires might rage in another part. The radio system consists of several VHF high-band repeaters, some on mountaintops, along with several simplex stations controlled via telco lines back into the dispatch center. Now, with single-point

regional dispatching, the dispatch center has become an all-important hub in our communication system. It has to remain operable even in the face of powerful storms that seem to plague the southeast.

For that reason, lightning and surge protection, along with backup power, were my foremost concerns. With single-point dispatching, downtime is an unaffordable luxury.

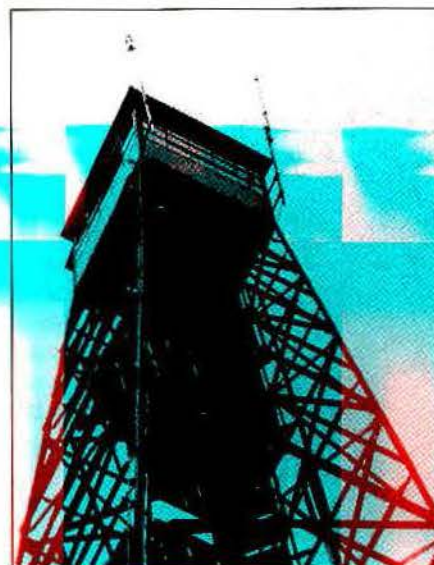


Photo 1. The old way. This old lookout tower is now abandoned, but it still stands to remind us of the way things used to be.

However, we could hand off dispatching to another region through the T1 lines in an emergency (assuming the T1 circuits were operable). A large backup generator was installed along with a UPS system. Only critical components were served by the UPS. The generator could service most of the building. Because the generator is fueled by natural gas, it could run indefinitely without concern for fuel.

Figure 1 below shows a simplified block diagram of the interconnection of the generator, UPS and dispatching equipment. The UPS supplies only the critical components of the dispatch system. The UPS is a "standby" unit as opposed to an "online" unit. Even with the UPS in the standby mode, the power feeding the UPS outlets passes through the UPS and is conditioned by it. In the event that the UPS doesn't "like" what it sees from the commercial power source (or generator), the UPS will switch to "inverter" operation, using the internal batteries to produce power. As long as the power feeding the UPS is within tolerance (frequency and voltage), the UPS simply passes the power through (while using it to float-charge the UPS batteries).

If the commercial power fails, the UPS will automatically go to the "inverter" mode and

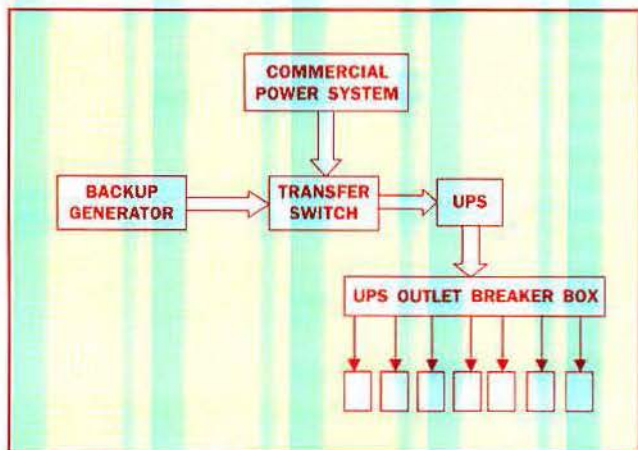


Figure 1: Block diagram of the backup power system at the dispatch center.

Kinley, a certified electronics technician, is regional communications manager, South Carolina Forestry Commission, Spartanburg, SC. He is a member of the Radio Club of America. He is the author of *Standard Radio Communications Manual: With Instrumentation and Testing Techniques*, which is available for direct purchase. Write to 204 Tanglewyde Drive, Spartanburg, SC 29301. Kinley's email address is hkinley@aol.com.



Photo 2. The new way. South Carolina Forestry Commission air patrol pilot Jimmy Tobias stands beside his Cessna. Tobias flies air patrol to detect wildfires and to direct fire-fighting resources in the

suppression of those wildfires. Ground crews rely heavily on Tobias' skill in directing their movements and keeping them safe as they 'work' the fire.

generate power for the UPS outlets. At the same time, the generator will start. Once the generator comes up to full power and stabilizes, the transfer switch will switch the electrical system to the generator. If the generator power is within tolerance, the UPS will revert to the "normal" mode, and the internal batteries will resume charging from the generator power source. Thus, the UPS is only online for a short period of time (assuming that the generator is operating correctly).

Recently, we experienced a power failure late in the afternoon. No thunderstorms were in the area, but the power was out for an hour or so. The UPS took over until the generator came on line. However, once the generator came on line, the UPS would switch back and forth between "normal" and "inverter" operation. This indicated that the UPS did not like the power coming from the generator. A quick check of the generator revealed that the generator frequency was fluctuating. The UPS frequency window was set to accept a frequency variance of $\pm 3\text{Hz}$, the maximum window allowed.

We called a service company to service the generator. During the testing and "adjusting" of the generator, a voltage rise or surge set off something akin to a fireworks display in the dispatch center—complete with smoke, fire and screams as the dispatchers ran out the back door! Several of the lower-priced plastic-cased surge protectors literally smoked and tripped circuit breakers on the breaker panel. These are basically MOV shunt devices that ultimately fail in the shorted mode—often in an impressive dis-

play that will scare off even the most daring dispatcher. After we finally got everything stabilized and back "up," we were able to coax the dispatchers back into the building.

At that point, I promised that I would get

those plastic-cased cheap surge protectors replaced with better units that would not threaten to catch fire.

I will continue this saga next month. Until next time—*stay tuned!*

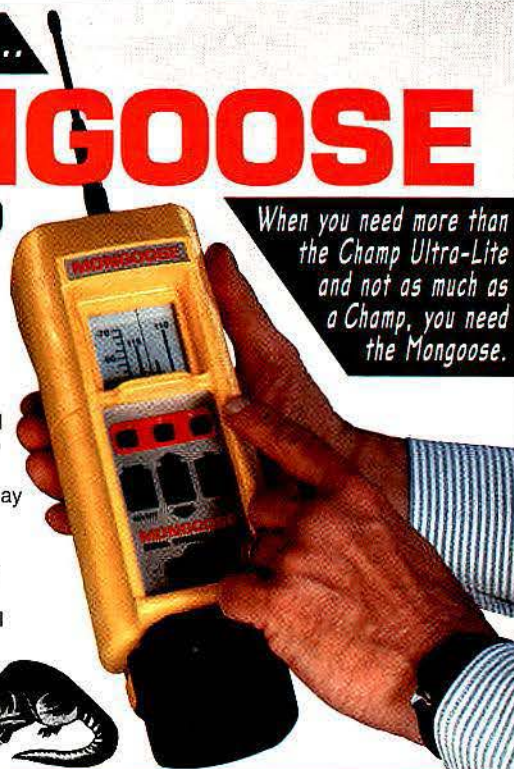
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RFS Cablewave builds state-of-the-art facility

RFS Cablewave Systems has moved into its new manufacturing plant, headquarters facility and eastern regional service center in Meriden, CT.

The new facility occupies about 10 acres on a 52-acre parcel of land. The structure itself is 1/4-mile long and contains a 310,000-square-foot manufacturing plant for cables, antennas, warehousing and shipping, and 40,000 square feet for the executive and administrative offices, sales, marketing and engineering departments. The facility's project cost exceeded \$20 million.

The grand opening is set for October. The open house for employees and their families was on June 20.

"The building was a massive effort of so many people," said George Gigas, president of RFS Cablewave Systems. He explained

that one of the critical components of the new expansion effort had been the development of a partnership between RFS Cablewave, the state of Connecticut and the city of Meriden. RFS Cablewave chose the Meriden site after extensive economic and demographic analysis of various locations within and outside the state of Connecticut.

"It took nine months to design, and 13 months to relocate," Gigas said.

The main office has a tall, open entryway with floor-to-ceiling windows that allow a view of the surrounding forest. The actual manufacturing plant is clean, with clearly marked walkways and blue machines. "We painted all the machines, and we have acquired some new machines," Gigas said.

"The facility is outstanding as far as energy conservation is concerned," Gigas said.

The building has a sophisticated climate control system that maintains comfortable temperature in all seasons. All roof surfaces are pitched to avoid standing water and ice build-up in the winter. To conserve energy, the lights in individual offices also shut off automatically when there hasn't been any movement in a certain period of time.

For employees, two lunchrooms hold new vending machines, bulletin boards, and tables and chairs. There are patios for outside dining as well. The facility contains expandable meeting rooms.

"Everything is useable space," Gigas said. "We can easily expand to twice our present capacity."

"With this new plant, we expect to satisfy any level of future demand in a very timely manner," he continued. "The employees are crosstrained on different products and processes to enhance manufacturing flexibility."

RFS Cablewave Systems employs more than 300 people in the facility, an increase of 100 employees from a year ago. The company also predicts the creation of 285 additional jobs over a three-to-five-year period.

"We have people who have been with the company more than 10 years, some 20 or 30 years. We have very little fluctuation. People like it here," Gigas said.

RFS Cablewave Systems, founded in 1973, is the North American partner of the globally operating RFS group with manufacturing locations in Australia, Brazil, France, Germany and the United States. The six flags flying in front of the new facility represent these countries, and the state of Connecticut.

The company serves its customers in North America, Latin America and the Caribbean from the new facility as well as two other regional sales and customer service centers in Illinois and California, and a network of authorized stocking distributors.

The address for the main office is: 200 Pondview Drive, Meriden, CT 06450.



RFS Cablewave's facility contains a 310,000-square-foot manufacturing plant.



Offices make up 40,000 square feet of the RFS Cablewave's headquarters.




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George Gigas has served as RFS Cablewave president for 13 years.

FCC Notes

New rules promote commercial use of 47GHz military band

The FCC recently adopted a Memorandum Opinion and Order and Notice of Proposed Rulemaking representing the next step in the commercial utilization of the 47.2GHz-48.2GHz frequency band. This band was initially developed for military use and now holds the potential for commercial use. The Commission concluded that it should take a flexible approach to regulating the "frontier" band, allowing licensees to offer any service consistent with the United States Table of Allocations and the Commission's rules. The Commission is finding that the dominant use probably will be fixed and point-to-multipoint satellite services.

WTB announces new management team

The Auctions and Industry Analysis Division of the Wireless Telecommunications Bureau (WTB) has a new management team. Amy Zoslov has been named chief of the division. She has served in the Mass Media Bureau, the Cable Services Bureau, the office of Commissioner Duggan and the WTB. Zoslov was most recently deputy chief of the division. Mark Bollinger has been named deputy chief (legal) and will oversee the legal and finance branches of the division. He was previously the division legal advisor. Louis Sigalos has been named deputy chief (operations) and will oversee the auction operations and expenditures management branches of the division. He previously was the chief of the auction operations branch.

AMTA requests rulemaking

The American Mobile Telecommunications Association (AMTA) has requested that the FCC adopt rules changing licensees' status from primary to secondary if those licensees have not started using "spectrally-efficient" equipment by a certain date. AMTA proposes that the conversion date be determined by the licensees' market. The licensees in markets 1-50 would have until Dec. 31, 2002 to change their equipment; markets 51-100 would have until Dec. 31, 2008, and the remaining markets would have to convert by Dec. 31, 2020. The FCC has not acted or commented on the proposal, nor has it begun a rulemaking proceeding, which would be required for AMTA's request to be adopted.

GN Netcom completes acquisition of ACS Wireless

GN Netcom, based in Copenhagen, Denmark, has completed the previously reported acquisition of ACS Wireless, a headset manufacturer. ACS Wireless stockholders approved the terms of the agreement. A new company, GN Netcom, Inc., has been formed by the merger of GN Netcom's North American organization, GN Netcom/Unex and ACS Wireless.

P. Michael Fairweather will be president of GN Netcom, a position he held previously with GN Netcom/Unex. The company plans to continue operations in both Nashua, NH,

and Scotts Valley, CA.

The new company will continue to design, manufacture and market telephone and computer headsets under the brand names GN Netcom UNEX and ACS. Products are sold to the mobile, call center, commercial and consumer markets through the organization's worldwide distribution.

"Our customers, distributors and employees will all benefit from this merger," Fairweather said. "We have spent the last few months planning a smooth transition, and are ready to move ahead quickly."

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Tellabs, Coherent to complete merger

The antitrust division of the U.S. Department of Justice has reviewed the merger of Tellabs and Coherent Communications Systems and will not oppose the merger. The two companies anticipate that the merger will be completed in September.

The company will design, manufacture and market echo cancellation and conferencing products for international telecommunications companies, cellular and PCS providers, and network operators.

Duke Energy markets towers, property holdings

Duke Energy announced that it has created a subsidiary, Duke Communication Services, to market more than 34,000 existing tower and property holdings in 33 states to help meet the growing need for antenna sites.

Since 1996, Duke has been working with wireless providers and local city and county planners in North Carolina and South Carolina to install antennas on top of electric transmission towers. This has enabled wireless providers to market their services faster, less expensively and with less difficulty than if they had to construct their own free-standing

towers and antenna structures. The existing tower sites have been received by planners and local communities as alternatives to free-standing towers with single attachments.

Jim Miller, general manager of Duke Communication Services, said: "The creation of Duke Communication Services will take this effort a step further by leveraging Duke's existing communications tower network across the eastern United States to offer the wireless industry thousands of desirable co-location tower sites. These additional sites will help the wireless industry develop their systems, so they can offer customers the reliability they demand."

Duke Communication Services is an unregulated division of Duke Energy Transmission and offers the following services to the wireless industry:

□ co-location sites on more than 320 existing communications towers ranging in height

from 50 feet to 600 feet along Duke Energy's 31-state natural gas transmission system and Duke Power's 20,000 square-mile service territory in North and South Carolina.

□ complete turn-key services to design, construct, install, own and manage co-location antenna sites throughout the eastern United States.

□ thousands of potential co-location antenna sites within or near the rights of way on Duke Energy's 12,700-mile electric transmission system and 22,000-mile natural gas transmission system.

□ more than 30,000 antenna sites on existing electric transmission towers, ranging from 75 to 200 feet, in North and South Carolina.

□ a user-friendly computer application to identify existing antenna sites available on the World Wide Web at www.dukecomsvcs.com.

The new subsidiary will work closely with Duke Engineering & Services, another Duke subsidiary, in the areas of land acquisition, design engineering, project management and construction. It also will work closely with Duke Power and Duke Energy's natural gas pipeline telecommunications groups.

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News Notes

Dictaphone, Stratford, CT, has formed a commercial markets sales division within



Elwell

Ron Elwell, senior vice president and general manager of Dictaphone's CRS group. "Voice recording is no exception. Our team of specialists thoroughly understands the needs of call centers, so they're better equipped to help customers sort through the technology choices."

The **American National Standards Institute** (ANSI) approved another standard in Project 25 suite of standards, according to Project 25 Steering Committee Co-chair **Art McDole**, who also noted that the Telecommunications Industry Association (TIA) is publishing "Project 25 Vocoder Description" ANSI/TIA/EIA-102-BABA-1998. **John DiSalvo**, chairman of the Project 25 User Needs Sub-committee, said the formal adoption of the standard would ensure its industry-wide acceptance.

Dataradio, Atlanta, has installed IBM's middleware network technology on the existing Dataradio Wireless Network at Arizona Public Service (APS), Phoenix. "Reliability and stability were our main concerns in implementing a new system," said senior communications engineer **Claes Laestander**. "We wanted to use our existing Dataradio network, and nothing else would fit. CAD was not considered a good solution."

Motorola's Land Mobile Products Sector (LMPS), Schaumburg, IL, will manage wireless communications equipment facilities on Houston-based **Waste Management North America's**

sites across the country. Under the agreement, Motorola's Antenna Site Division will manage future facilities at Waste Management's transfer stations, buildings and recycling facilities. "Motorola can help property owners, such as Waste Management, maximize their potential revenue from these communications facilities," said **Joni Glockner**, director of operations for the antenna site division.

Dataradio, Atlanta, will supply Sedgwick County, KS, with a countywide mobile computing system. The plans include a multi-site 800MHz data network from Dataradio to support the Sheriff's Office's mobile

computing needs. The network will enable other public safety entities within the county to utilize mobile computing. The mobile computing system will consist of four base sites for countywide coverage, as well as the networking of 200 Sheriff vehicles through a Dataradio Multi Site Controller.

Crown Communications, Pittsburgh, PA, has acquired all of the common stock in a Dallas-based partnership called **Abner**, including Abner's principle assets, which are five communication towers that serve the Dallas metropolitan area. Abner was founded

about six years ago to take ownership of towers that its partners had owned individually as part of other communications businesses in which they were involved, including SMR, paging and community regulators.

TriTech Software Systems, San Diego, CA, has installed its VisiCAD for Fire/EMS at the San Diego Fire Department. The Windows NT-based computer-aided dispatch (CAD) system incorporates vehicle routing, high-resolution integrated mapping, comprehensive graphical reports, and a fire

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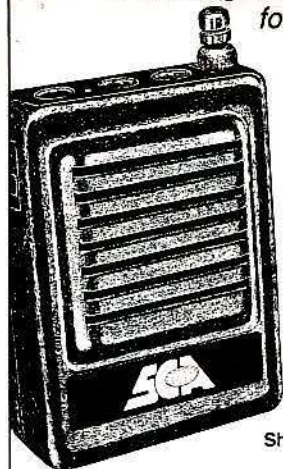
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and emergency medical triage system. "VisiCAD for Fire/EMS" advanced feature set enables fire departments to reduce response times, streamline resource deployment and enhance dispatcher productivity," said **Christopher D. Maloney**, president of TriTech.



Maloney

Nextel Communications, McLean, VA, has purchased a centralized test and monitoring system from TTC,



Mayerick

Germantown, MD. The \$3.1 million sale included TTC's Centest 650 remote test units, TTC's NetAnalyst client/server-based test management software, Clear Communication's EarlyWarning intelligent surveillance software and TTC's professional services support. "Our agreement with Nextel further establishes the need for TTC's proactive, systems-based approach to network monitoring and testing," said **Gary Mayerick**, president, systems and software, TTC. "TTC's centralized test system will enhance Nextel's ability to assure network availability and will play a critical role in verifying and maintaining Nextel's network performance for its nationwide customers."

Lenbrook Wireless Communications, Pickering, Ontario, has appointed **Pat Connelly Repair (PCR)**, Indianapolis, as the service center for warranty repairs of Powerwave Technologies' (formerly Milcom International) land mobile amplifiers sold by Lenbrook. PCR will also handle all non-warranty repairs of Powerwave land mobile amplifiers.

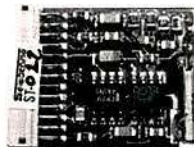
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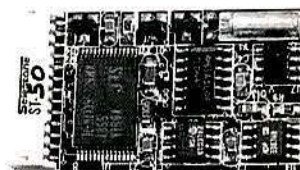
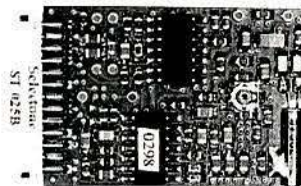
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Paging Equipment

Decoder intended for maintenance, monitoring



Hark Systems has developed the new Verifier II, a Flex and POCSAG off-the-air paging decoder. This product does not require a separate computer for decoding paging information. It is a portable decoding device intended for maintenance and monitoring of paging channels and is

suitable for field use by system technicians. The device tracks and holds, internally, basic statistical information as well as decoded pages for unattended operation. It is packaged with a frequency-agile receiver. It decodes 512-, 1200-, and 2400-baud POCSAG. Flex format decoding includes 1,600 and 3,200 bi-phase and 3,200 quad-phase formats. It can also be used with optional software, connected to a computer via an RS-232 interface, to produce extended statistics and to gather information from multiple channels.

Circle (351) on Fast Fact Card



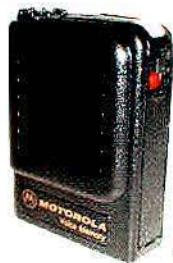
Notification system accommodates 500 pagers

The VS3200 from Visiplex is an advanced security desktop notification system. It is equipped with a full-size keyboard for operations and programming, and it accommodates as many as 500 pagers. Pages can be initiated through the keyboard, a telephone, an RS-232 serial port or contact closures. The system includes

an interface with wireless pendants and other wireless devices. The system allows customers to connect to any security, alarm or access control system, and it provides fail-safe alarm reporting. Options include telephone interface, wide-area paging, expandable contact points, multiple RS-232 ports, text-sniffing interface, cellular link backup and printed reports package.

Circle (352) on Fast Fact Card

Paging system developed for fire, rescue squads



The Paging and Wireless Service Center has developed a product designed for fire departments and rescue squads. It has its own private voice paging system, called a Monitor Adapter, designed for the Motorola Keynote pager. The adapter will monitor the channel and automatically squelch the pager to eliminate background noise between transmissions. The adapter is a small, printed circuit board that mounts inside the pager housing. It is available as a separate add-on to retrofit existing pagers or available installed in a reconditioned pager. The price of the modified Keynote pagers can be less than half of the price of purchasing new traditional monitoring pagers.

Circle (353) on Fast Fact Card

Pager acts as wireless personal digital assistant

NEC America has developed the Beacon Data Pager, a wireless personal digital assistant (PDA) with full alphanumeric messaging capabilities. Data can be transferred from desktop or laptop devices to a Beacon Data Pager by using infrared technology and special Microsoft software. Users may take important personal information management (PIM) data with them, such as appointments, reminders, addresses, phone numbers, contact lists and other specialized lists of data. The pager uses Flex messaging protocol and has one of the largest display screens available in a pager, eight lines by 21 characters. The pager also features 128Kb memory.

Circle (354) on Fast Fact Card

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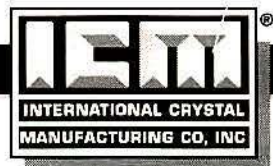
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Circle (41) on Fast Fact Card

READERS' CHOICE

Of the new products in the February 1998 issue, this one generated the biggest reader response. For more information on this product, circle the corresponding Fast Fact Card number on the card found in the back of this issue, and mail the card to us.

Monitor receiver performs in severe conditions

The Minitor III alert monitor receiver from Motorola's Customer-Owned Messaging Group has more capabilities including scanning, vibrating alert and expanded calls. With features such as corrosion-resistant packaging and more than 35 hours of battery life, the Minitor III alert monitor receiver performs under severe conditions. The receiver's compact design also includes field programming capabilities for frequency and codes, and can handle six calls per channel. The Minitor III receiver's channel scan capabilities allow customers to listen to channel traffic on two separate channels, so important calls are received. The Vibra-page feature alerts customers to incoming pages, keeping them informed in loud and tough conditions.



Circle (500) on Fast Fact Card

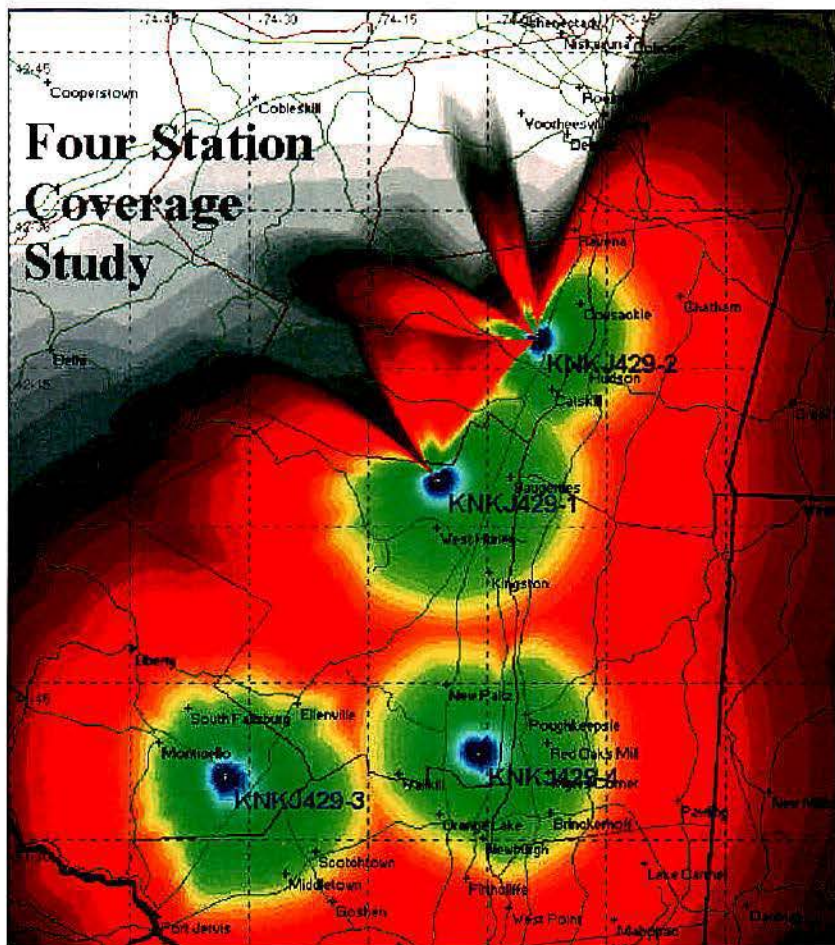
Pager's antenna ups reception range

The Sceptar tone and voice pager from Shinwa Communications of America is a completely synthesized VHF pager with PC programming capability. The small pager tolerates rough handling. Its cellular-like telescopic antenna is designed to improve reception in areas that are beyond most pagers' ranges. It has up and down volume control buttons instead of rotating volume controls.



Circle (401) on Fast Fact Card

Four Station Coverage Study



Circle (65) on Fast Fact Card

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Receiver displays LTR-coded fields

Optoelectronics has added two features to the Xplorer test receiver. The receiver will now display five fields of LTR information: area code, go to repeater, home repeater, user ID and free repeater. The portable, hand-held test receiver locks onto a transmitter from 30MHz-2GHz in less than one second. Once the signal is captured, the frequency of the transmitter is displayed along with the LTR information. In addition to LTR, the Xplorer will also decode CTCSS, DCS and DTMF, as well as display the relative signal strength and signal deviation. The second feature added to the receiver is frequency blocks. Frequency blocks allow the user to input a specific frequency range as a lock in or lock out. With 10 frequency block memories, the user may now program frequency ranges to be locked in and tested exclusively, without interference from other signals.

Circle (402) on Fast Fact Card



Wireless data terminal works on tabletop

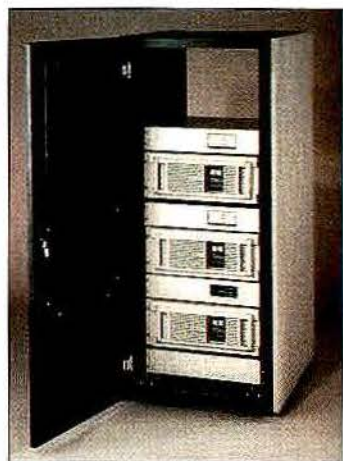
Eagle Wireless International has upgraded its industry-standard Microbeep wireless data terminal to a tabletop unit. This product is designed for in-house paging, or as a low-cost extension to existing systems. It works for specialized applications such as remote control, remote monitoring, security systems or temporary data systems. The Microbeep-sx can connect directly to all types of personal computers, modems, or to a paging network interface using standard formats. It also works autonomously as a stand-alone unit. The terminal works with Windows 95 and can handle all paging frequencies—VHF through 900MHz. It can transmit POCSAG data at 512bps, 1,200bps or 2,400bps to numeric, tone-only or alpha-numeric receivers. Power outputs of 1W to 5W have provisions for connection to external transmitters for higher power requirements. The terminal can monitor as many as 16 switch type inputs and transmit messages when one of these inputs changes state. A freestanding unit can monitor processes or alarms and send pre-programmed pages as needed.

Circle (403) on Fast Fact Card

Power supply provides N+1 redundancy

Liebert's UPStation GXT multimodule is an uninterruptible power supply that is scaleable from 3kVA to 9kVA, with N+1 redundancy. The multimodule is designed for distributed processing applications that are critical enough to warrant a redundant approach, such as high-end servers, critical nodes, clustered servers or hosts. The multimodule, a build-as-you-go system, features hot-swappable batteries, SNMP software communications and UPS backup. The multimodule uses Liebert's Intellipod (power output distribution) technology.

Circle (404) on Fast Fact Card



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Circle (57) on Fast Fact Card

Indoor, outdoor RF extension antennas deliver entire PCS band

Maxrad's series of PCS site antennas, the MFB-19000 series, is compact, economically priced and suited for indoor and outdoor RF extensions. The omnidirectional antennas are factory-tuned to 1.900MHz and cover the entire PCS band (1.850MHz-1.990MHz) with VSWR under 1.5:1. Three models are available, offering either 4dBi, 6dBi or 8dBi gain with corresponding vertical beamwidths of 32°, 20° and 12°. The antennas' broad vertical beamwidth provides coverage at the close ranges typically involved in RF extension. A slim, low-profile (height ranges from only 9"-24", depending on gain) and weather-resistant U.V. stabilized pultruded fiberglass radome allows fast, inconspicuous mounting. The antenna can also be painted to blend with its background.

Circle (405) on Fast Fact Card

Radios offer multimode operation

The Titan FM two-way portable and mobile radio series from Midland USA features alphanumeric control heads and programmable channel scanning. The unit offers multimode operation, programmable channel bandwidth, and 12.5/15kHz or 25/30kHz channels. It is available with as many as 150 channels, programmed in 15 groups. The mobile control heads offer an LCD with a 12-character display, which identifies the channel in use. Users can monitor frequencies while reverting back to two assigned channels if a transmission comes in on those channels, by employing dual-priority channel-scanning capability. The scan expander lets users add programmed groups and delete add-back channels within groups.

Circle (406) on Fast Fact Card



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Low-VSWR jumpers support PCS uses

The low-VSWR Flexwell jumper assemblies from **RFS Cablewave Systems** are for PCS applications. Because of the higher operating frequency band 2GHz, PCS systems demand low VSWR characteristics. With these jumpers, PCS operators can pass transmission line sweep tests every time, preventing construction testing delays. Each jumper assembly is 100% tested for input VSWR, which is guaranteed to be better than 1.08:1 (28.3dB minimum return loss) across 1.850MHz-1.990MHz. These jumpers are waterproof and are available in special lengths to meet installation needs. Available in both 1/2" foam and 1/2" superflexible cables, premium jumpers have been introduced in the following connector configurations: 7/16 DIN male/7/16 DIN male; 7/16 DIN male/7/16 DIN male right angle and 7/16 DIN male/N male. An N male/N male version is available for 1/2" standard foam cable.

Circle (407) on Fast Fact Card

Low-loss filters block VHF, UHF harmonics

MicroLab/FXR has expanded its range of lowpass filters, which are designed for VHF and UHF base stations and similar applications. The LB-CO1 and LB-CO3 feature low passband loss, low intermodulation and 500W average power capability at an economic price. With only a few solder joints and an air dielectric, the loss has been minimized and reliability enhanced. Model LB-CO1 is designed for passband up to 174MHz and model LB-CO3 up to 329MHz. With a stopband defined as the band from the second harmonics to 2.5000MHz, each achieves a minimum of 55dB harmonic suppression, a rejection that typically extends to beyond 12GHz. When compared to lumped element filters often used at these frequencies, the filters will run cooler, reflect less power back to the transmitter, and, with only two solder joints per assembly, will be considerably more reliable.

Circle (408) on Fast Fact Card

Repeater works with any trunking radio

Loudoun Communications' Comm-link 800 (MHz) is a lightweight, multi-featured, portable repeater. The repeater works with any conventional-mode trunking radio, from any distant location, and is suited for use in emergency operations. The repeater can be used by electric utilities, Secret Service, FBI and SWAT teams. It can operate on 100 channels with a 25W power output and 10- to 40-mile range (depending on terrain). Weighing 35 pounds, the repeater requires only one person for both installation and operation. The repeater is fully programmable in frequency and CTCSS, and is multi-CTCSS tone capable.



Circle (409) on Fast Fact Card



NEW!

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The complete line of AEA antenna and cable analyzers are now available **FACTORY DIRECT** at the lowest possible cost. Each antenna analyzer gives a **graphical display of SWR** curves with variable sweep width and center frequency. The **30-150, 150-525, and 806-960 MHz** antenna analyzers are each \$499.95 plus \$7.50 shipping and handling. The **SWR-121 HF** analyzer covers 1-32 MHz and is priced at \$299.95 plus \$7.50 shipping and handling.

We are pleased to announce the **NEW AEA CIA-HF** Complex Impedance Analyzer that features all the features of the above SWR Analyst products. In addition, the CIA-HF gives graphical displays of impedance, reactance, resistance and relative phase angle with a vector display mode. Automatically display the 2:1 SWR points or any two other user selectable bandwidths. Display reactance and the conjugate match value of inductance or capacitance necessary to resonate a mis-tuned antenna. The CIA-HF covers a frequency range of 400kHz to 54 MHz and has a low introductory factory direct price of **\$359.95** plus \$7.50 shipping & handling in CONUS.

The **AEA CableMate™** graphical Time Domain Reflectometer (TDR) is packaged in the same style package as the SWR analyzers. The CableMate shows multiple faults in a cable on the graphical display. Virtually any multi-conductor cable may be **tested for shorts, opens or impedance lumps**. Designed specifically for RF service techs, the CableMate has a special RF filter mode to kill any interference. The CableMate is an **excellent** device for **measuring the length of most any cable** for inventory purposes. It will also directly show the 25 MHz return loss. The CableMate is priced at **\$359.95** plus \$7.50 shipping and handling in CONUS.

All AEA analyzer products come standard with a **serial computer interface**. Optional DOS applications software (except CIA-HF) with interface cable is **\$29.95** each. With this software you can store the graphical data for your antennas or cables for future reference.

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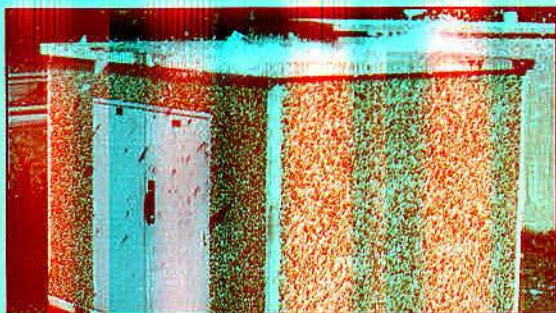
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Prices and Specifications subject to change without notice or obligation.

Circle (60) on Fast Fact Card

Buildings feature post-tensioned design

The Easi-set buildings from **Easi-Set Industries** create enclosures for communications, sensitive electrical controls, maintenance equipment storage, Hazmat-spill containment and mechanical housing. The buildings meet UL752 level four bullet resistance. The designs also withstand Zone 4 seismic and up to 150mph wind loads. The post-tensioned building, which will withstand a 100-pound block of ice dropped from 200 feet without any damage, is available in clear roof spans of 12', 20', 24', 30' and 40'. The buildings protect materials from weather, fire and theft. The maintenance-free building is transportable, and in most cases, installation takes less than one day because there is no need for foundations or footings. The buildings are modifiable to customer's requirements.



Circle (410) on Fast Fact Card

Headset speaker imitates human ear shape

GN Netcom/Unex's Optima-G is available in monaural and single-wire binaural and is made with quick disconnect (QD), making it compatible with all GN Netcom amplifiers, including the MPA-II multipurpose amplifier and the wireless MPA satellite. The Optima-G is a light professional grade headset featuring an ergonomically contoured speaker that imitates the shape of a human ear, a noise-canceling microphone, a strong Duraflex boom, Pure Sound Accubass speakers, and a Stay Put ratcheting headband for all-day comfort.

Circle (411) on Fast Fact Card

Clamps aid in lightning protection

Harger Lightning Protection's family of pipe clamps provide 1½" of contact area to ensure sufficient electrical contact for both ground fault and lightning current. These clamps can be connected to ground conductors via exothermic connections and standard compression lugs. The UPC.75/1.25 provides bidirectional grounding capabilities, making it a suitable connection for grounding fence rail to fence post applications. Sizes range from 3¾" up through 6" nominal pipe diameters. All clamps are manufactured from highly conductive tinned copper and feature stainless-steel hardware.



Circle (412) on Fast Fact Card

ANTENNAS

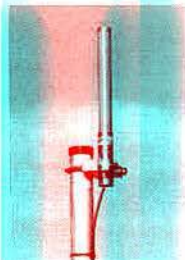
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Circle (61) on Fast Fact Card

Protocol provides data, voice over one channel

AMP Wireless Systems' suite of flexible wireless communication products and protocols are engineered to meet the needs of specialized mobile radio (SMR) users. Opensky operates in the 800MHz SMR band and provides simultaneous data and voice communications over a single RF channel in either trunked frequency-division multiple-access (FDMA) or time-division multiple-access (TDMA). This provides users with a significant advantage over existing systems that allow either voice or data, but not both, to be transmitted at any given time. Consisting of software-based digital mobile radios, portables and base station equipment, Opensky provides users' compatibility with legacy systems and expandability. It is suitable for service in the public safety, utility, transit, taxi and field service arenas. Opensky communications protocols are extensions of the Advanced Mobile Phone System (AMPS) cellular digital packet data (CDPD) stack and are TCP/IP based. This allows users to access applications such as email and FTP (file transfer protocol). It also facilitates voice communication over Internet protocol (IP). Its trunked FDMA and TDMA protocols support both circuit-switched and packet-switched data.

Circle (413) on Fast Fact Card

Mobile radio serves VHF/UHF market

Ericsson's mobile radio, the KMC, serves the mid-tier, conventional VHF/UHF market, providing a variety of options from channel guard to PC programmability. The KMC operates in both narrowband and wideband modes and is flash-programmable to handle future software upgrades. Other features of the mobile include radio interrogate, radio disable, radio enable, group call and status message transmission.

Circle (414) on Fast Fact Card

Vocoder delivers better speech quality

The low-data rate AMBE+ vocoder from Digital Voice Systems provides speech quality and performance under bit errors and background noise conditions. Operating at 4.8kbps and 4kbps, the vocoder achieved mean opinion scores (MOS) of 3.849 and 3.646 respectively in an independent evaluation. The vocoder is suited for specialized mobile radio, satellite communications, computer telephony and other voice and storage applications where low data rate and toll quality are prerequisites.

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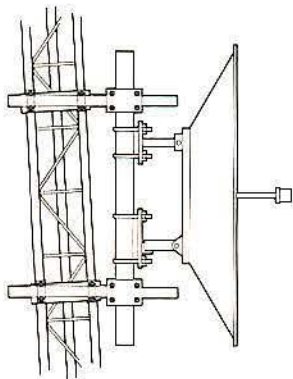
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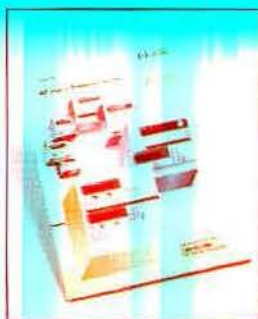
Circle (39) on Fast Fact Card

Disk features surface-mount tech

Pace's CD-ROM features surface-mount technology with more than 50 step-by-step procedures to help with the installation and non-destructive removal of surface-mount components applicable to assembly and rework operations. Procedures for removal and replacement of misaligned, poorly soldered, damaged or faulty components are illustrated. The disk includes more than 25 video clips to show the procedures and to provide greater visual assistance when needed. The CD-ROM includes component, tip and handpiece identification information as well as the Pace catalog.

Circle (451) on Fast Fact Card

Guide offers power products



Hewlett-Packard has published the 1998/1999 editions of its *System Power Products Selection Guide* and *Power Products Catalog*. The 16-page guide (literature no. 5966-1707) contains an overview of HP's power product line, highlighting key features and specifications. The 65-page catalog (literature no. 5966-1706) provides R&D and production engineers with technical information on more than 125 models of dynamic measurement

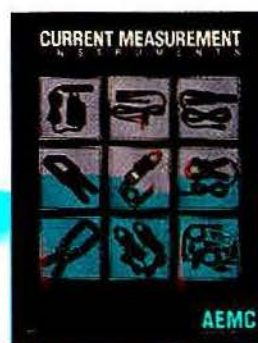
dc sources, ac power source/analyzers and harmonic/flicker test systems.

Circle (452) on Fast Fact Card

Catalog includes line of probes

AEMC Instruments' *Current Measurements Catalog* includes information about the AEMC line of clamp-on current probes covering the entire spectrum of applications, from electrical panels to substations. AEMC current probes measure current without interrupting the circuit and extend the assuring capabilities of DMMs, recorders, power meters and loggers. The numerous jaw sizes are designed to accommodate a wide variety of conductor diameters and ranges.

Circle (453) on Fast Fact Card



Directory contains 2,100+ listings

The Electronic Industries Alliance has released the 1998 edition of its annual *Trade Directory & Membership List*. The directory contains more than 2,100 listings representing the full spectrum of the \$500 billion U.S. electronics manufacturing industry. The publication lists EIA members' corporate and division locations, telephone numbers, executive level personnel, trade names and number of employees, as well as specific company products and services. It includes a section on company facilities by geographical location and a cross-reference of companies by product category as well as company logos and advertising.

Circle (454) on Fast Fact Card

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Circle (66) on Fast Fact Card

people



Hansen



Farina



Mance



Stewart

Mark Hansen, lead engineer, Special Antenna Division at Centurion International, Lincoln, NE, advances to engineering manager, Power Products Division.

Sal Farina, national sales manager for Uniden Private Radio Communications, Fort Worth, TX, moves up to vice president of sales.

Robert D. Mance leaves PDS Worldwide in Pompano Beach, FL, to become vice president of Mac Com, Fort Lauderdale, FL.

Michael Stewart exits Ernst and Young, Chicago, as sales and marketing manager to join LCC International, McLean, VA, as senior vice president for North America.

Bruce Richter, manufacturing unit leader for Joslyn Electronic Systems, Santa Barbara, CA, becomes director of engineering and manufacturing for Panavise, Reno, NV.

Jeff Greene departs Larsen Electronics, Vancouver, WA, as production services leader to become general manager for Gamber-Johnson, Stevens Point, WI.

Joseph A. Banos rejoins RF Industries, San Diego, as president of its Neulink Telemetry Division, replacing **Arthur Ekroos**, who becomes an independent sales representative for Neulink Products.

Changes at TruePosition, Vienna, VA:

Dan Principe exits Ericsson Radio Systems, Reston, VA, as director of business control and operations, to join TruePosition as vice president, operations. **Paul Czarnecki**, TruePosition's director of engineering and implementation, moves up to assistant vice president, engineering and implementation.

Gareth Davies exits Motorola as director of multimedia services for Europe, the Middle East and Africa and becomes international sales and marketing director for Airtouch, Aylesburg, Bucks, UK.

Charles Johnston, general manager, PCS, for Omnipoint, Cedar Knolls, NJ, advances to chief operating officer.

Jill Prince leaves her position as public relations director for Uniden America in Fort Worth, TX, to become marketing communications manager for the wireless division of NEC America in Irving, TX.

Anders Ericsson departs Ericsson Data AB in Malaysia as regional director to become president of Allgon Enterprises, Fort Worth, TX.

Marisa Ollins, a 1998 graduate of George Washington University, Washington, DC, joins the Electronics Industry Alliance, Arlington, VA, as public affairs coordinator.

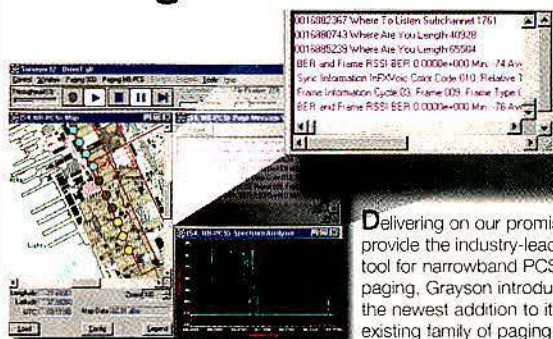
Steve M. Wilcox, tower technician and field instructor, becomes the manager of Monroe, WI-based ComTrain's new office in Sacramento, CA.



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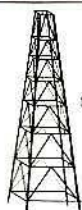
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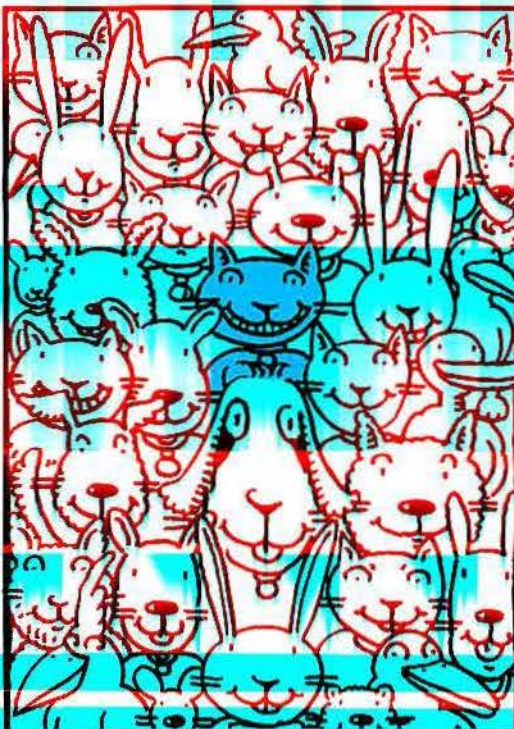
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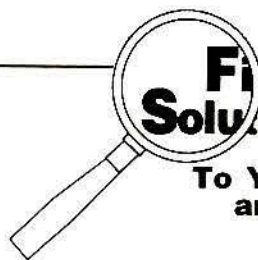
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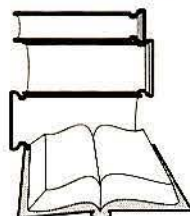


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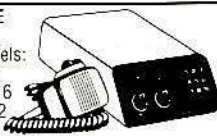
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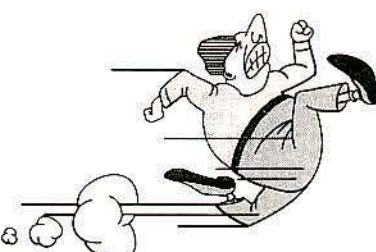
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CMC '98
November 11-15

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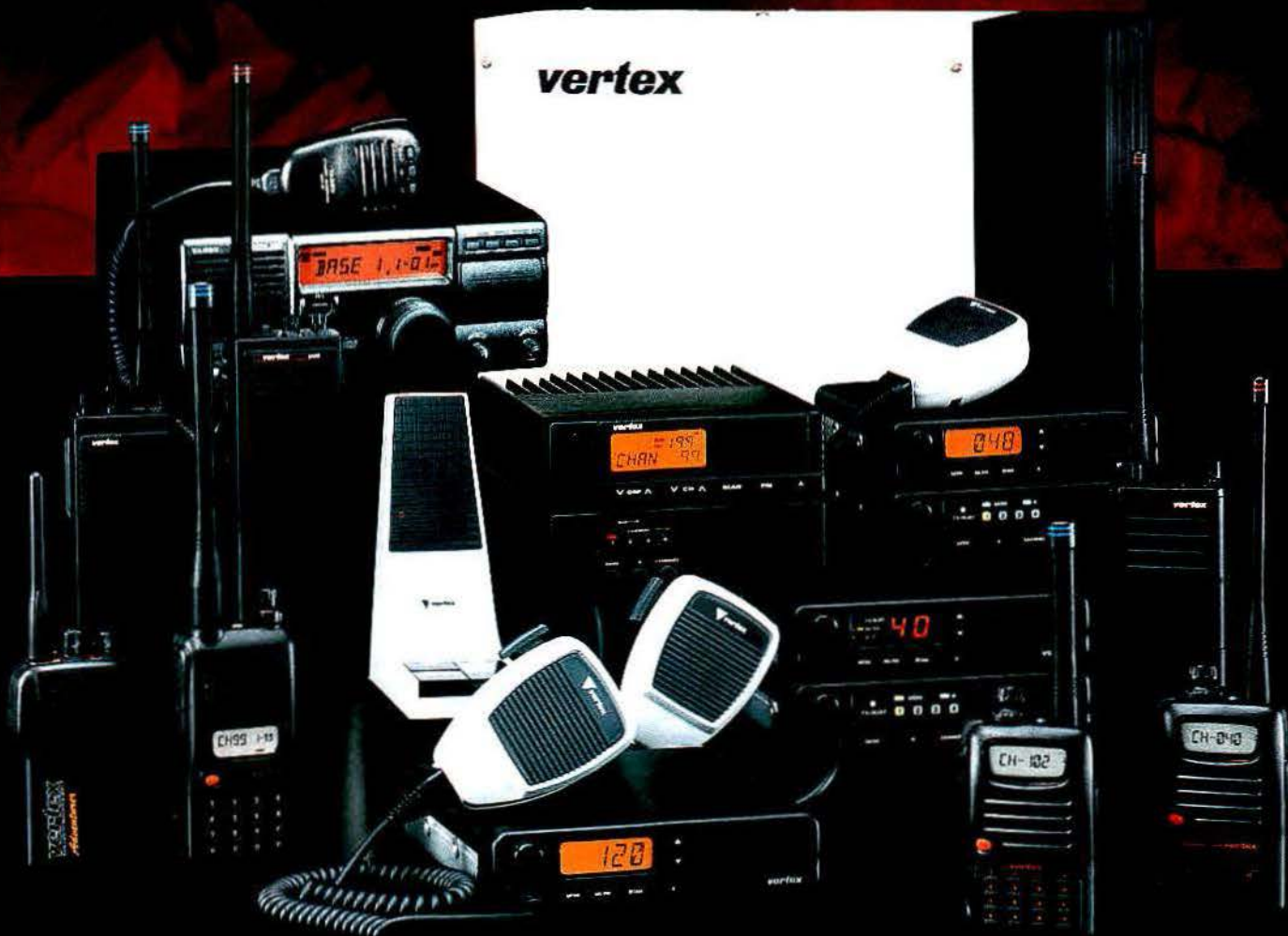
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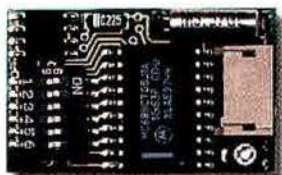
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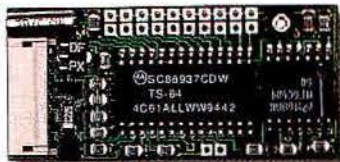
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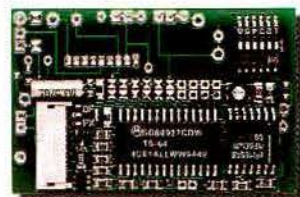
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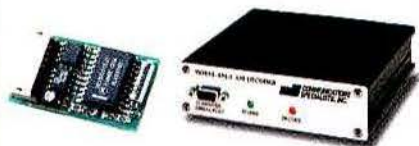
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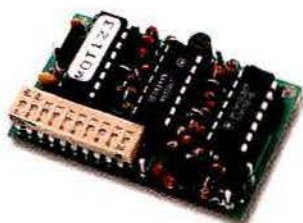
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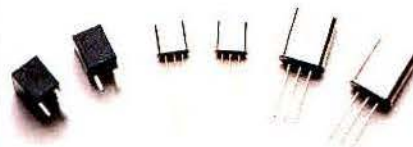
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